THE MARINE REVIEW

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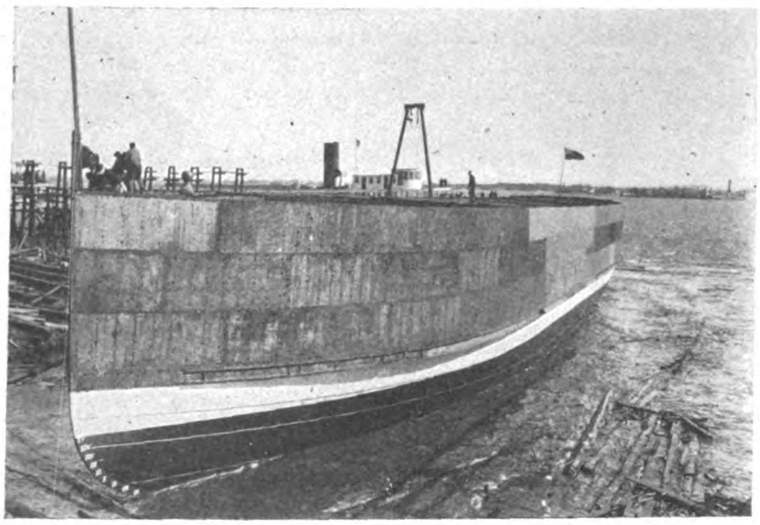
CAR FERRY ONTARIO NO. 1.

The MARINE REVIEW in its last issue of April 11, described the car ferry Ontario No. 1, launched at the Toronto yard of the Canadian Ship Building Co., for the Grand Trunk railroad. The dimensions of the car ferry are as follows: 316 ft. 1 in. length over all, 54 ft. beam molded, 56 ft. beam extended or width over main deck, 20 ft. 6 in. depth molded, 37 ft. 6 in. depth from shade deck, making the ship of greater size not only in displacement but also in length and beam than anything afloat on Lake Ontario. It is of the ice-breaking type, especially designed and constructed throughout to provide for use in ice-breaking incidental to car-ferry service during the winter months. With a capacity of twenty-eight loaded cars on a load draught of 15 ft. a speed of 15 miles per hour will be attained.



CAR FERRY ONTARIO NO. 1.

The steamer is equipped with twin-screw triple-expansion engines 20½ in., 32½ in. and 54 in. in diameter with a 36-in. stroke, the engines to develop collectively 3,000 I. H. P., when turning up a hundred revolutions per minute. The air pumps and the condensers will be of the independent type, there being an air pump installed for each engine, and of the Dean Bros. manufacture. The balance of the auxiliary machinery consists of two Canada Foundry ballast pumps, Blake bilge and feed pumps, cooler, sanitary and small tank pumps. The screw propellers are of the sectional type 12 ft. in diameter with a pitch of 14 ft. There are four boilers of the Scotch type, 14 ft. in diameter by 12 ft. in length with a steam pressure of 175 lbs. A tubular feed water feeder with an area of 400 ft. of heating surface will be supplied. The draft will be of the Howden forced draft induced by two 72-in. diameter American Blower Co. fans. The electric generators will have a capacity of 450 16-candle power lights and will be furnished by the General Electric Co.

On the shade deck will be erected a deck house 185 ft. long, the forward part of which will be staterooms to accommodate 100 passengers; also a general cabin, a lady's cabin, gentlemen's smoking room, dining room, purser's office, etc., aft of these will be accommodations for the chief engineer and his crew, also the steward, waiters and cooks, while in the texas will be located accommodation for the captain and his crew.

The advent of Ontario No. 1 will inaugurate a service between Charlotte, N. Y., and Cobourg, Ontario, a distance of about 60 miles, making a connecting link between the Grand Trunk railway system and the Buffalo, Rochester & Pittsburgh railway. This will be of great advantage, not only to the shippers of eastern Canada, but also to those of the middle states, as a considerable saving in time in the transportation of freight between the two countries will be effected. From the Pennsylvania and Ohio steel and coal service the new service will obviate the handling of trains through terminal railroad yards that are at present very congested, and at all times overtaxed. The freight will instead be carried through to Charlotte placed aboard the ferry and delivered to the Grand Trunk at Cobourg without delay—a saving between Pittsburg and Montreal from 4 to 7 days being effected. Equal despatch will also be at the command of the lumber centers of Ontario; also the ore shipper from the silver mines of the Cobalt district and the extensive iron mines of northern Ontario.

The Pacific Mail steamship Mongolia recently went ashore on the coast of Japan, while attempting to avoid a collision with a sailing vessel. She was floated after lightering a part of her cargo, and was found not to be damaged beyond the loss of an anchor.

The Merchants' & Miners' liner Gloucester has returned to service after having been at Newport News for repairs. She had the tail-end shaft drawn as well as undergoing general repairs.

CONSTRUCTING THE LUSITANIA.

In the course of his paper read before the Institution of Naval Architects, Mr. W. J. Luke, who is one of the directors at the Clydebank works of Messrs. John Brown & Co., dealt technically with the design, building, and launching of the Lusitania, the 25-knot Cunard liner now being completed at Clydebank. Mr. Luke said that in consultation with Lloyds surveyors (the vessel being classed with Lloyds) it was decided that, on the basis of mild steel construction, the materials of the hull should not be subjected to a stress exceeding ten tons per square inch; the calculations in this connection followed the usual conditions accepted in previous cases, namely, that consideration should be given to the possibility of the vessel meeting with waves of her own length, and whose height from trough to crest would be one-twentieth of the wave length. The preliminaries having been thus adjusted, calculations were proceeded with, the results making it apparent that the maximum bending moment (of slightly over one million foot tons) occurred in the condition when nearing port with bunkers almost empty. The stress is one of hogging, the corresponding sagging stress being only about half this amount. The corresponding bending moments in a load condition assumed at a displacement of about 20 per cent in excess of the arrival displacement are slightly less for hogging and for sagging—not very different from the case previously considered. In view of the fact that the severest stresses were such as put the upper works in tension, it was determined to adopt high tensile steel of reduced scantling in these parts, provided such material could be produced of satisfactory quality. In the end it was demonstrated that a satisfactory material could be produced whose average ultimate tensile strength was at least 20 per cent greater than the average for the usual quality of mild steel, and in consequence a reduction in certain scantlings of 10 per cent from the scantlings fixed for mild steel was adopted. This reduction not only caused considerable saving in weight, but made for better riveting, owing to the thinner plates and smaller rivets used. It also has the effect of lowering the neutral axis of the transverse section, and increasing the stress on the material beyond the accepted limit for mild steel, but this increase of stress comes entirely on high tensile steel, and is very moderate in amount.

Mr. Luke next gave many details of the scantlings, stating that the stem of cast steel weighed 8.37 tons; the sternpost, also a steel casting, 59.43 tons; the rudder, composed of three steel castings, 56.43 tons; and the four spectacle eyes, 60.24 tons. The rudder area is 300 square feet. Having described the arrangements for testing the high tensile steel, he dealt with the results. The average ultimate tensile strength of the mild steel was 29.6 tons per square inch, against 36.8 for normal high tensile, and 36.6 for annealed high tensile steel. The average ratio of the elastic to the ultimate tensile stresses to which the specimens were subjected were 43.5 per cent for the mild steel, 47.7 for the normal high tensile, and 53.4 for the annealed high tensile. In the strength calculation it was assumed, and so specified to the makers, that mild steel should have an ultimate tensile strength of from 28 to 32 tons per square inch of original sectional area, and high tensile steel, free from nickel, and not annealed—such as was used in the construction of the ship—should have an ultimate tensile strength of from 34 to 38 tons, an increase of 20 per cent. The normal high tensile steel was above expectation as regards ultimate tensile strength by 2.2 per cent, and above the mild steel by over 24 per cent. Taking, however, the expected increase of 20 per cent, and with an increase of 9.7 per cent in the ratio of the elastic limit stress to the ultimate tensile stress, the high tensile material was 32 per cent better than the mild steel. If we take the increase for tensile strength as 24 per cent, and for elasticity as 9.7 per cent, it shows a superiority of 36 per cent. The elongations on a length of 8-in. and on 8-in. specimens were sometimes as high as 30 per cent, and never below 23 per cent, which compared very well with the specified minimum of 20 per cent in mild steel. The non-temper test had to be satisfactorily met, and bending tests were conducted on 11-ft. specimens of mild and high tensile steel, and they were found to be of about the same value for withstanding flexural stresses. A series of percussion tests clearly demonstrated the superiority of the high tensile steel to the mild steel with which it was compared, and the material was consequently accepted. Mr. Luke next gave details of the launching of the ship. The total time which elapsed from the release of the triggers until the vessel was fully afloat was 86 seconds; of this period 22 seconds were absorbed in tripping the keel blocks left under her, and in this operation she only progressed about one foot down the ways. This gives an average speed of 12.2 ft. per second for the remainder of the journey to the water. The velocity was so moderate that the vessel was brought up with her bow about 110 ft. from the shore, the total weight of drags in use having been 1,000 tons. Concluding, Mr. Luke expressed a hope that the trials may be in every way successful, and such as will entirely justify the enterprise of the builders and the owners in the great step they have taken in assuming the responsibility of constructing these large vessels.

There was a long and interesting discussion on Mr. Luke's paper, which turned largely upon the use of high tensile steel and upon the utility of the new Cunard liners as scout cruisers in war.

Lord Brassey said that the new Cunarders, the Lusitania and the Mauretania, were the finest specimens yet produced, and had great uses. They might properly be called in a very real sense a great national asset of themselves. Such ships did not pay, and they could only be built by the aid of the government. He felt confident that the policy was a sound one, and he believed it was generally approved in the country.

STEADYING OF SHIPS AT SEA.

At the forty-eighth session of the Institution of Naval Architects, held in Glasgow last month, Sir Wm. H. White put before the members the result of experiments with Dr. Schlick's gyroscopic apparatus for steadying ships. The experiments were carried out in the Seebar, formerly a first-class torpedo boat in the German navy, and, as appeared from Sir Wm. White's remarks, the gyroscopic apparatus—a fly-wheel one metre in diameter, oscillating on athwart ship trunnions, and making up 300 revolutions a minute—was placed in a compartment before the boiler room. From personal observations, Sir William said, he could certify to the remarkable steadying effect of the gyroscope. In all cases the practical effect was to extinguish rolling motion of the ship almost immediately. The Seebar was practically deprived of rolling motion, and was simply subjected to heaving motions, as successive waves passed her as she lay broadside on to the sea. Many seamen had expressed the opinion that there would be great danger of seas breaking on board a vessel the deck of which remained practically horizontal. The Seebar trials showed that the fancied danger did not exist, and, to use Dr. Schlick's words, "The waves seemed to disappear under her, and she rose with a gentle motion vertically upwards, and sank again just as gently into the trough of the sea, without even spray coming on board to any extent worth mentioning." As to the future use of the gyroscope, Sir William White said he thought it would be wise to proceed gradually. Cross-channel and coasting passenger steamers of high speed formed a class in which the steadying effect of gyroscopes would be of great advantage, and there would be

no difficulty in fitting them. Ocean-going passenger steamers were now remarkably steady at sea under most circumstances, and in them the advantage of the new apparatus would be less important than in smaller vessels; but the experiments showed conclusively that gyroscopes could be designed which would exercise a sensible steadying effect upon even the largest passenger steamers on service. Among warships it might be anticipated that experiments would be made before long with the gyroscope apparatus in destroyers and in the smaller classes of cruisers. For large war vessels the tendency of late had been to accept much greater metacentric heights. Should this prove to increase the frequency of rolling, it would undoubtedly be possible to secure greater steadiness of gun platform by means of the gyroscopic apparatus.

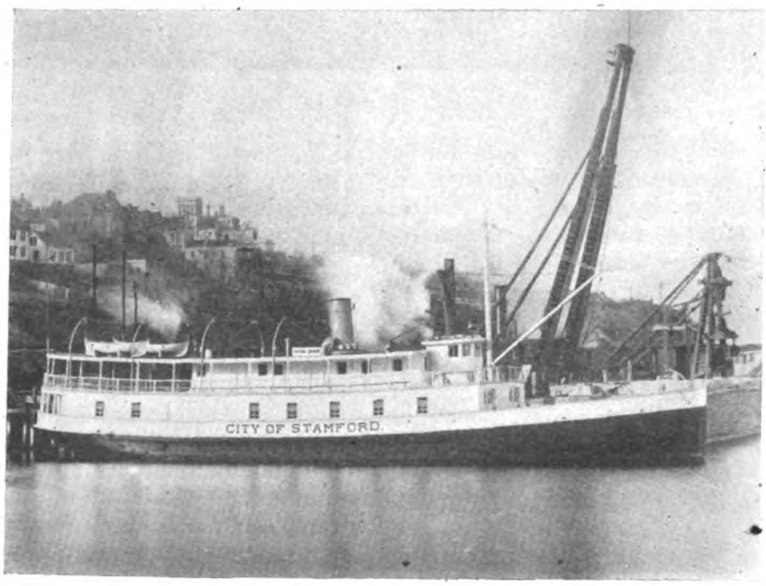
CITY OF STAMFORD.

The Portland Co., Portland, Me., has just completed the steamer City of Stamford for the North & East River Steamboat Co., which is to be placed immediately on the route from Stamford to New York. She is a combined passenger and freight boat with an extra large carrying capacity on the main deck which can take care of about 400 tons of freight. The galley, saloon and state-rooms are all on the upper deck with the exception of two rooms aft for the engineers. The forecastle is fitted up for twelve men. This vessel carries a mast with cargo boom forward for handling heavy freight. She is also arranged with a telescoping smoke stack so as to be able to go under low bridges in case of necessity. She has a complete electric lighting plant with 14-in. Rushmore searchlight, built and installed by the Portland Co.

The dimensions of the boat are as follows: Length over all, 145 ft.; beam over guards, 35 ft.; beam over planking, 28 ft.

She is designed for a shallow draught boat and not to draw over 7 ft. of water. She is fitted with the Portland Co. fore and aft compound marine engine 15—32 x 22-in.—450 indicated H. P.

The boiler is of the Scotch type, 12 ft. diameter, 11 ft. 7 in. long and contains three 36-in. Morison furnaces 9 ft. long. The boiler has 217 3-in. tubes 9 ft. long. Total heating surface 1,772 sq. ft. Total grate area 54 sq. ft. Grate bars 6 ft. long. Working pressure 165 lbs. The condenser contains 750 sq. ft. of cooling surface. The propeller is of the sectional type 8 ft. diameter, 10 ft. 9 in. pitch. She is fitted with fresh water tanks having capacity of 5,000 gallons, and carries about 40 tons of coal in the bunkers. She has a large hold forward and aft for storing away freight if necessary. The above steamer left Portland April 11 for Stamford, Conn., in charge of Capt. John Berry, of Portland, and a full crew of engineers, firemen, oilers, etc., taken out of the shops of the Portland Co. This boat is specially designed for the particular work required of her and the builders are very much pleased with her performance.



THE CITY OF STAMFORD.

The submarine torpedo-boat Lake, while practicing for the tests in the government competition in Narragansett Bay, lost one of her outfit of Whitehead torpedoes, which are the property of the government and are valued at about $4,500 each.

INTERNAL COMBUSTION ENGINES.

At a recent meeting of the Institution of Civil Engineers, a paper of exceptional value was read by Mr. Dugald Clerk, M. Inst. C. E., on "The Limits of Thermal Efficiency of Internal Combustion Engines." The paper is one of considerable length and highly technical, and we are, therefore, only able to touch on a few of its features.

At the outset the author referred to the work of the institution committee on the standards of efficiency of internal combustion engines. The committee were satisfied that with good engines, giving their best economy, the actual efficiency divided by the ideal efficiency determined by a standard recommended by them could be expressed by a ratio which varied between 0.5 and 0.7. This was deduced from separate tests made by Professor Meyer and Professor Burstall. Professor Burstall's tests also showed how inefficient design would decrease the ratio, as in some of his tests means involving greatly increased cooling surfaces were employed to increase the compression, and were found to considerably diminish the ratio. These tests showed further how too high flame temperature also decreased the ratio. The committee required, however, further knowledge as to the effect of the dimensions of the engine on the ratio, and accordingly they made tests on three engines of 5 in., 9 in., and 14 in. diameter cylinders respectively, giving indicated powers of 6, 24, and 60. In these engines, taking the mechanical efficiency to be 88 per cent, and calculating the I. H. P. from B. H. P., they found that the efficiency ratios were 0.61, 0.65, and 0.69 in the three engines. The tests showed, therefore, that by bearing in mind the slight changes in the ratio due to difference in dimensions, a close approximation to the best indicated efficiency to be expected from a given compression could be obtained by the use of a factor varying between 0.61 and 0.70, according to the dimensions of the engine. The tests also showed very clearly the small increase in economy of large engines in comparison with small ones, there being only 12 per cent increase between 6-H. P. and 60-H. P. The author has examined the results of the test made by the committee and has made some further experiments on the large engine used in the test, with a view to finding the true heat distribution in the engine.

The balance sheet given by the committee is as follows:

	L.	R.	X.
Exhaust waste	35.3	40.0	39.5
Jacket waste	23.5	29.3	25.0
Radiation	7.6	10.0	7.3
B. H. P.	26.7	28.3	29.8
Total	93.1	107.6	101.6

In obtaining this balance sheet the exhaust waste was determined by calorimeter, jacket waste measured, and the radiation includes friction of the working parts. The B. H. P. was determined by rope brake. In order to reason as regards properties of the working fluid, it is necessary to know the I. H. P., the loss of heat during explosion and expansion, and the heat in the gases at the end of expansion. These quantities are not given in the ordinary balance sheet as determined above. In the ordinary test the jacket loss is always overestimated, because some heat which ought to go to the exhaust calorimeter flows to the water jacket after the opening of the exhaust valve and all through the exhaust stroke of the engine. The piston friction also will appear in the water jacket. The author has therefore attempted to adjust the balance sheet from data given in the committee's report. Taking the mechanical efficiencies for the three engines, L, R, and X, as 0.84, 0.85, and 0.86, the friction percentage of total heat is 5.1, 5, and 4.9 respectively. Deducting this from the jacket waste, corrected values for heat to water jacket, 21, 26.8, and 22.6 per cent are obtained. Using these values, and reducing to percentage, assuming the error in total heat is not in the I. H. P. item, a new balance sheet is obtained:

	L.	R.	X.
Exhaust waste	41.1	37.1	39.9
Jacket waste	27.1	29.6	25.4
True radiation	27.1	29.6	25.4
I. H. P.............	31.8	33.3	34.7
	100.0	100.0	100.0

The ideal efficiencies in these engines are practically the same, and, assuming that one-third of the heat going to the engine is converted to work and that the heat loss occurs near the beginning of the stroke, the difference between the jacket plus radiation losses in any two engines should be three times the difference between the indicated horsepowers. In the L and X engines this is found to be exactly the case.

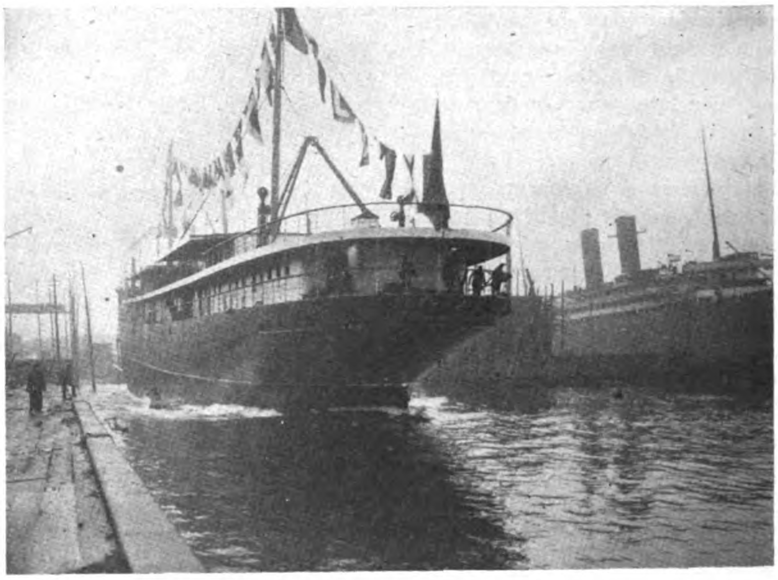
In 1884 the author made experiments on cooling after explosion in a closed vessel. Many other investigators have since done similar work, but cooling of a cylinder having a moving piston had never been investigated. The author made further experiments, and determined the cooling in the X engine. The engine was run at normal speed, and when a charge had been drawn in, the rollers actuating the inlet and exhaust valves were slipped, so that the valves remained shut. The explosion then took place, and the gases, instead of being discharged, were alternately compressed and expanded. An indicator card gives a cooling curve, showing temperature fall during successive revolutions of the engine. From these cards the mean apparent specific heat of the gases in the cylinder has been deduced, the gases being practically the same composition as those in the committee trials. The values given increase with increase of temperature, and have been called apparent specific heat values, because certain facts discovered are inconsistent with the change being entirely specific heat change. Calculations, assuming these numbers to be the true specific heats, are, however, very nearly accurate. From the cooling curves, and specific heat values so determined a balance-sheet has been obtained for the X engine as follows:

	Per Cent.
Heat flow during explosion and expansion..	16.1
Heat contained in gases at end of expansion.	49.3
Indicated work	34.6

Comparing this with that found by the committee, it is seen that the indicated work is the same in both. There is, however, less heat flow during expansion, and more heat in the gases at exhaust. This shows that about 21 per cent of the heat in the gases at the end of expansion goes to the water jacket during the opening of the exhaust valve and exhaust stroke. This is considered a more accurate balance sheet than has yet been obtained. Calculating the ideal efficiency as before, the value 41 per cent is obtained. From the values of specific heat given, the adiabatic may be calculated, from which the ideal efficiency is found to be 39.5 per cent, showing that the actual engine has converted 88 per cent of the heat which it possibly could convert into indicated work. The new method has been checked by a test of a small Stockport engine in the author's laboratory, which gave similar results to those given by the X engine.

NEW BRAZILIAN STEAMERS.

At Belfast, Messrs. Workman, Clark & Co., Ltd., have recently launched the first of six steamers being built by them for the Lloyd Brazileiro of Rio de Janeiro. The vessel in question is the Ceara, which is 354 ft. long and has a gross tonnage of about 3,500 tons. All the six vessels are being built under Lloyd's special survey to qualify for



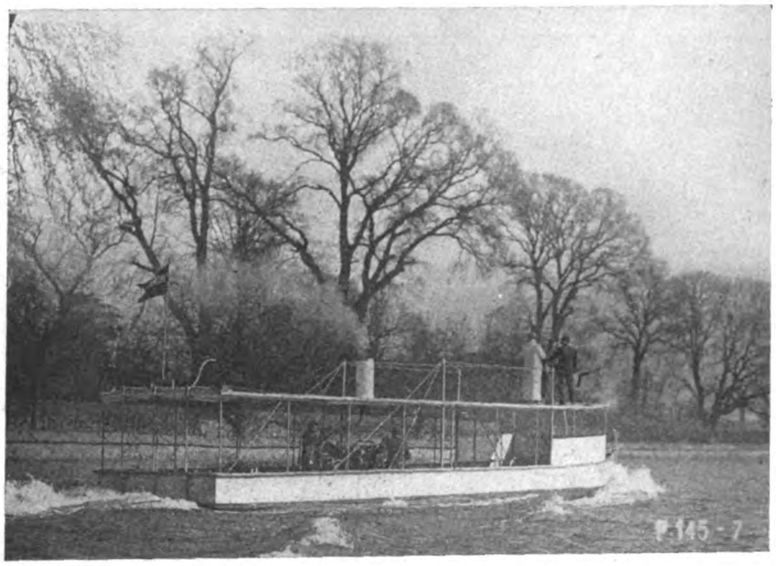
NEW BRAZILIAN STEAMER CEARA.

their highest class, and they will also fulfill the board of trade requirements for a foreign going passenger ship. In the design and arrangement of these vessels, the special requirements of the South American coast passenger and cargo trade have been carefully considered, and when completed they will be found to be the most comfortable and luxurious steamers afloat in those waters. Accommodation will be provided for upwards of 170 first-class passengers, 20 second-class and 300 third-class. The propelling machinery is being constructed in Messrs. Workman, Clark & Co.'s works, and consists of two sets of triple-expansion engines with all the latest improvements, and three cylindrical multitubular boilers working under Howden's system of forced draught. An auxiliary boiler is provided for supplying steam for the auxiliary engines and deck machinery. The designing of the vessels and machinery and the construction have been carried out with the co-operation and under the superintendence of Mr. A. Rosauro de Almeida, commander engineer of the Brazilian navy, who is the technical director-in-chief for the Lloyd Brazileiro.

Deibert Bros., Elkton, Md., have recently completed two barges for the James J. McNally Co. Philadelphia.

MOTOR PROPELLED CARGO BOATS ON THE NIGER.

A very interesting account has come to hand concerning what are probably the first motor boats of comparatively large size to be employed on the Niger and its tributaries for carrying cargo and for



MOTOR-PROPELLED CARGO BOAT SPIDER ON THE NIGER.

purposes of communication. These boats, the Spider and the Sandfly, are canoe shaped vessels, with very blunt bows and square sterns, flat-bottomed from end to end, with the exception of a slight rise fore and aft. They are 56 ft. long over all, 9 ft. beam and only 12 in. draught, fully loaded. They were built entirely by Messrs. John I. Thornycroft & Co., Ltd., of Chiswick, and were each fitted with a Thornycroft motor developing 50 B. H. P. on paraffin and 54-H. P. on petrol. With the exception that the Spider is propelled by screws in tandem, and the Sandfly by a stern wheel, the vessels are identical. The motors have four cylinders, 6 in. diameter by 8 in. stroke, cast in pairs, with valves arranged symmetrically on either side, inlet to port and exhaust starboard. The valves are actuated by vertical tappets, fitted with rollers on their lower ends.

An important feature of these engines is their accessibility, obtained by the special form of inspection doors fitted to the crankcase. Two doors are fitted on each side; these, when removed, leave the interior entirely exposed, including the camshafts, which may be taken out at the side instead of being withdrawn longitudinally. To facilitate this, the camshaft bearings are made in halves, the bottom part being carried by brackets in the main casting, and the tops being held in place by caps. The tappet rod guides are mounted on the respective cams, so that as soon as these are removed, the camshafts are left absolutely free.

Another important feature is the arrangement for running on petrol or paraffin, as desired.

A four-way connection is fitted in the induction pipe, the two horizontal branches going to the cylinders, the upgoing pipe leading to the paraffin vaporiser, and the downtake pipe to the petrol carburetor. Each of the latter pipes is provided with a throttle, so that if the motor is started up on petrol, the vaporiser throttle is kept closed, while if it is desired to change over to the heavier fuel after the engine has warmed up, the petrol throttle can be closed, and the paraffin valve opened.

Ordinarily the paraffin vaporiser is heated by the exhaust gases which are passed through it, but if no petrol is available for starting, the engine can be got running from cold in about 10 minutes by means of a paraffin lamp used to heat the vaporiser.

Half compression cams are fitted to the exhaust cam shaft to facilitate starting up, it being easy to get up a fair speed by hand under this condition, and as soon as the engine begins to fire, the full compression is given, when the motor picks up very quickly.

The first of these boats, the Spider, was completed and delivered to the Southern Nigerian government in the early summer of last year, and after incidental delays due to transport, was finally erected and launched at Old Calabar in July.

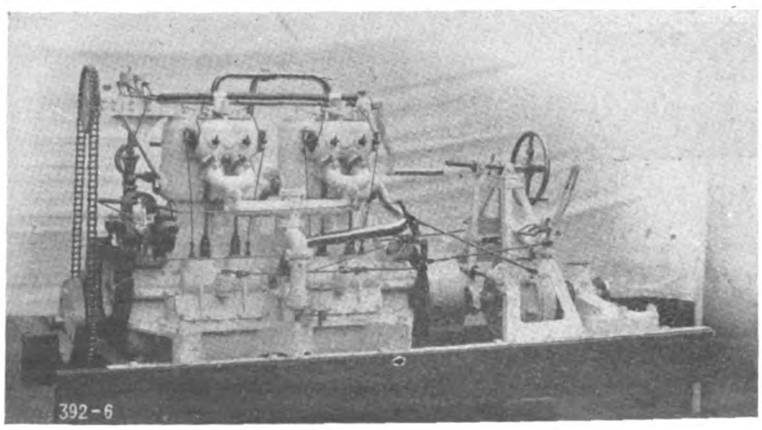
The first trip was of four hours' duration on July 24. This was accomplished without a stop, and without the least trouble from the motor, which used ordinary American paraffin exclusively.

After this the boat was put into commission, making regular runs, towing steel or else native canoes, and delivering mails, etc.

A notable run was one of 384 miles made last August, this being accomplished in 48 hours 23 minutes, or at an average of 7.68 miles per hour. The paraffin consumed was at the rate of 4.6 gallons per hour—an extremely economical figure under the exceptional conditions. No petrol whatever was used on this occasion also, and the engine and clutch gave absolutely no trouble.

Another very good performance was

Month.	Distance. (Miles)	Hours under way.	Paraffin consumed. (Gallons)	Remarks.
July	136	26.15	107	Average consumption of Paraffin, per hour = 3.3718 gallons. = 0.805 pints per B. H. P. per hour.
August	440	61.24	171	
September	666	113.39	351	
October	452	78.40	280	
November	916	162.25	546	
December	832	139.55	504	
Total	3,442	580.98	1,959	



MOTOR AND REVERSING GEAR OF THE SPIDER.

a journey of 60 miles from Itu to Indibe beach (Afikpo), towing two fully loaded steel canoes, on Dec. 25 and 26 last. This distance was covered in 14 hours 50 minutes, or at an average speed of about 4 miles per hour against stream.

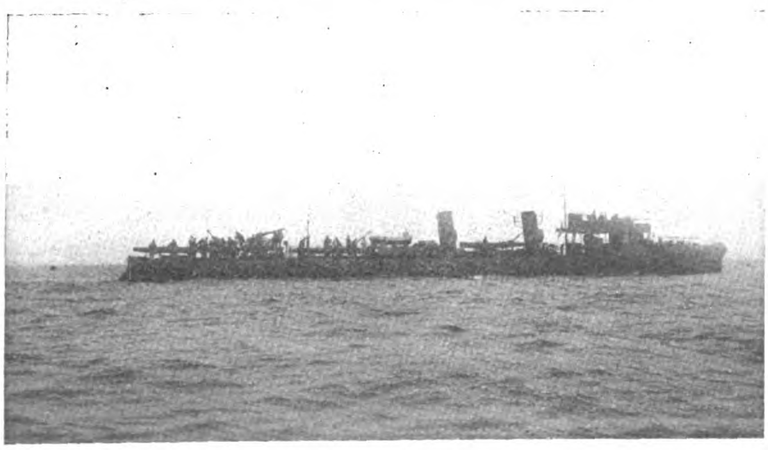
The following table, showing distances run, time under way, and consumption of fuel during certain periods, is worthy of note:

The motor invariably starts as easily on paraffin as on petrol, and as the cost of the former landed at Calabar is exactly half that of the latter, the advantages of using paraffin are enormous, more particularly so with the very low consumption shown above. The cost of fuel per mile works out at an average of about 7½d.

A circumstance which speaks remarkably well for the ease and simplicity with which this type of motor may be handled, is the fact that hitherto inexperienced natives have, within a very short time, mastered the details to the extent of being able to dismantle and reassemble it, while the Spider has been running for days together, and several hundred of miles from its base, in charge of a native driver only.

TURBINE DRIVEN TORPEDO BOAT.

The launch of Torpedo Boat No. 9 (lately known as H. M. S. Grasshopper) at the Chiswick Yard of Messrs. John I. Thornycroft & Co., Ltd., is the fifth of the new class of British turbine driven torpedo boats constructed at this yard, and in addition marks the end of the long and notable list of torpedo craft



TURBINE-DRIVEN TORPEDO BOAT GRASSHOPPER.

which has been constructed by this firm at their Chiswick Works, commencing with the Lightning—known in the service as Torpedo Boat No. 1—which was delivered in 1877.

The Lightning was a boat of 85 ft. in length, and capable of a speed of 18 knots, which was then considered most remarkable. Torpedo Boat No. 9 is 168 ft. long with a beam of 17 ft. 6 in. and a draught, under fully loaded conditions, of 5 ft. 11 in. She is fitted with Parsons turbines and Thornycroft boilers, using oil fuel; both the turbine machinery and boilers being constructed by Messrs. Thornycroft.

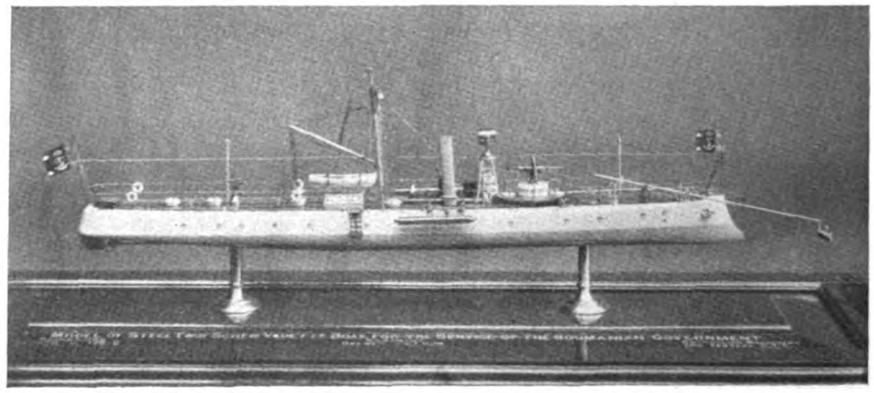
The contract speed is 26 knots, but in the case of the four earlier boats which have already undergone trials, this speed has been exceeded by considerably over a knot. The armament consists of two 12 pdr. quick-firing guns and three torpedo tubes.

Torpedo Boat No. 8, one of the sister vessels, having successfully carried out all her trials, was handed over to the admiralty officials at Sheerness by Messrs. Thornycroft on Saturday last.

Messrs. Thornycroft now propose to carry out all work of this nature at their Woolston Works, Southampton, where they are much more favorably situated than at Chiswick.

VIDETTE BOATS FOR ROUMANIAN GOVERNMENT.

The Thames Iron Works, Shipbuilding & Engineering Co., Ltd., London, has just delivered to the Roumanian government eight steel twin screw torpedo vidette boats. The vessels are 100 ft. long, 13 ft. beam, with a draught of water of 2.9½ and a displacement of 51 tons. They are fitted with twin screw compound surface condensing engines of 550-I. H. P. with water-tube boilers constructed by the Thames Engineering Works and steam generated with crude petroleum residium. At the official trial a mean speed of 18 knots was obtained over a 4-hours run and the results gave



MODEL OF VIDETTE BOATS FOR THE ROUMANIAN GOVERNMENT.

the highest satisfaction to all concerned. The vessels are fittted with a 47mm. gun on top of the conning tower forward and a small mitrailleuse gun aft. gear for dropping torpedoes over the side is fitted on both sides amidships and two spar torpedoes are fitted forward over the bows. The boats are also supplied with a powerful searchlight projector and are lighted throughout by electricity. Accommodation is provided for four officers and twelve men.

The voyage to Roumania was made from London to Rotterdam, thence up the rivers Rhine and Main, through the Ludwig canal into the Danube and down to Galatz. On the Ludwig canal no less than 101 locks were passed on the way to Kelheim where the canal joins the Danube. In spite of several difficulties which had to be encountered and overcome during their navigation through the rapids, etc., the vessels arrived safely at their destination without sustaining any serious damage.

GOOD ADVICE.

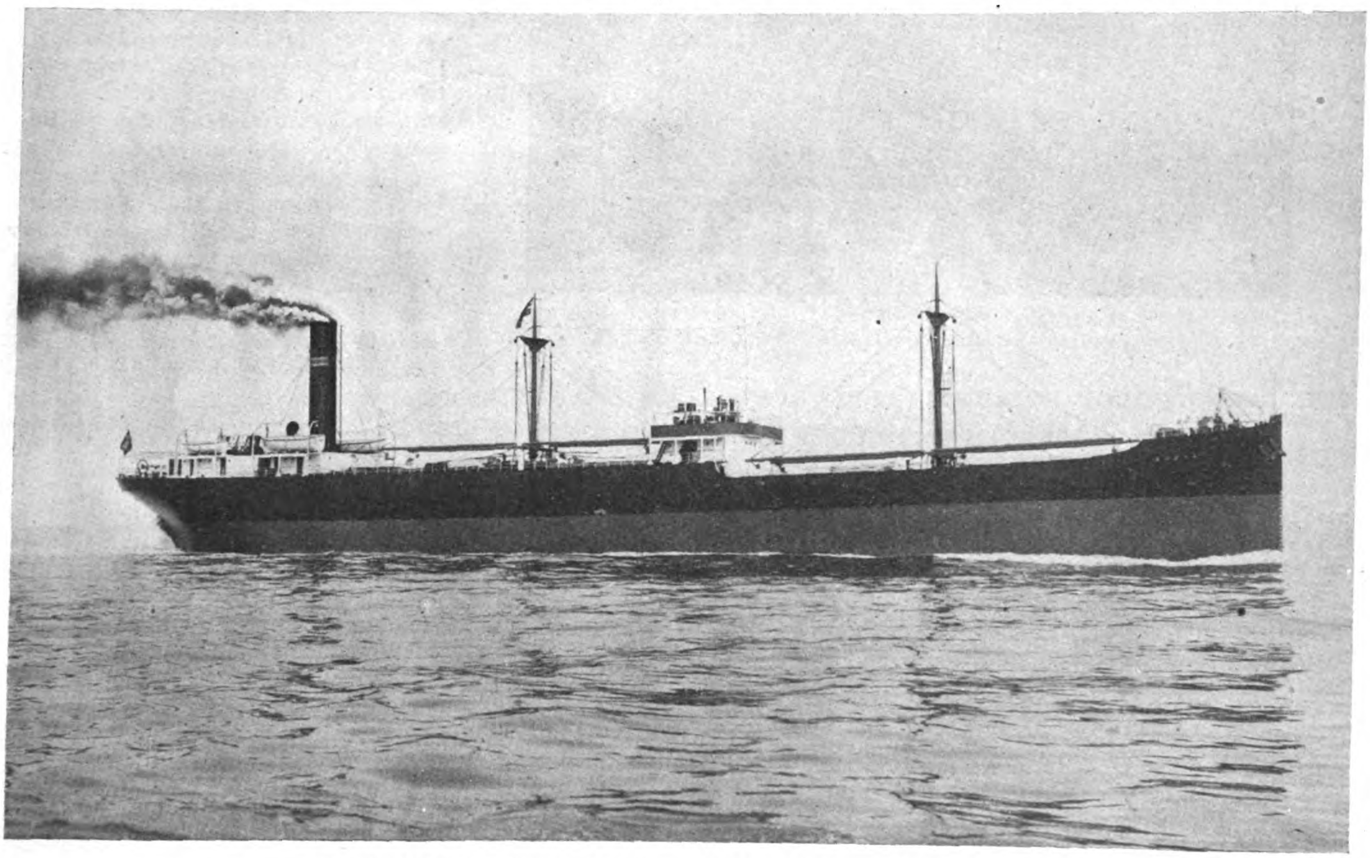
In *The Launch*, published by the Truscott Boat Manufacturing Co., under the heading of Practicalities appears the following item:

"Don't test the height of the gasoline in the tank with a dirty stick. You might get hung up with a stopped-up carburetor shortly after. It will be more trouble to clean the jet than it would have been to clean the stick."

It isn't necessary to paste this in your hat, but it is surprising how many persons there are constantly needing reminders of this kind. With a few alterations, this advice could be applied to many things.

THE LATEST IN CARGO BOATS.

The trial trip has just taken place of the steamer Sygna, built by Sir Raylton Dixon & Co., Ltd., of Middlesbrough, England, with cantilever frames on Harroway & Dixon's, John Priestman's, and Livingston & Sanderson's combined patents, to the order of Herr J. Ludwig Mowinckel, of Bergen, Norway. The Sygna, like her sister ships, is specially designed for the service of the Dominion Steel Co., and will be employed in carrying ore from Belle Isle to Sydney for that company. This cantilever type of ship, with water-ballast tanks carried alongside under the deck on each side, is the latest development of a modern cargo steamer. The water-ballast carried in these top-side tanks amounts to 800 tons, in addition to the 1,400 tons in the double bottom and peaks, which gives good immersion of the propeller when in light draught. This cantilever system dispenses with all beams, pillars, web frames, etc., so that the holds are absolutely clear from all obstruction, and the sloping sides of the top-side water-ballast tanks makes the holds perfectly self-trimming for coal, grain, or other such cargoes. Another remarkable feature of this vessel is the enormous size of the hatchways which are each 30 ft. wide by 36 ft. long, and these are covered by steel plate covers, whereby the necessity for tarpaulins is dispensed with. The covers consist of only eight pieces, in lieu of the usual seventy-eight required with the old system of wooden hatches. Her leading dimensions are 360 ft. by 52 ft. by 28 ft. 4 in., and she carries 7,400 tons d. w. on 23 ft. 9½ in. draught. She is single deck type, with long poop, and has a cargo capacity of 310,000 cu. ft. Her net register tonnage is only 2,464 tons. This is the eighth steamer of this type built by Messrs. Sir Raylton Dixon & Co. on the combined patents of Harroway & Dixon, John Priestman, and Livingston & Sanderson.



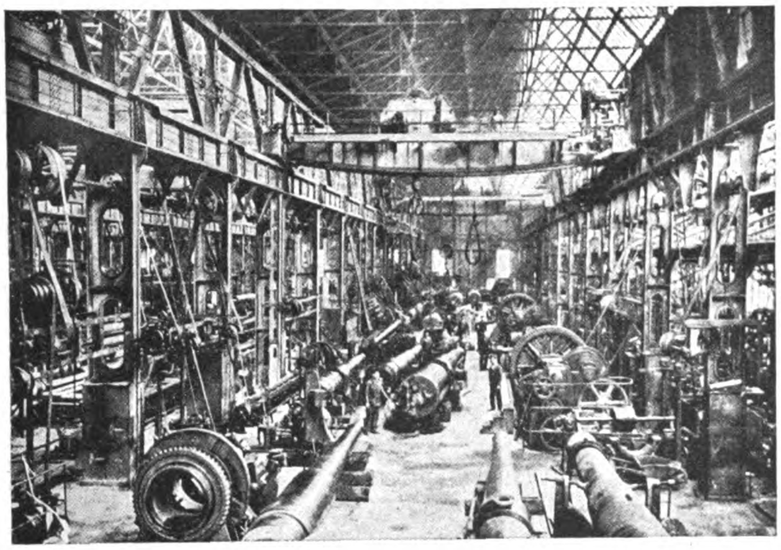
THE LATEST IN CARGO BOATS, THE SYGNA OF CANTLEVER CONSTRUCTION.

MESSRS. WORKMAN, CLARK & CO., BELFAST.

Interesting data regarding the growth of Messrs. Workman, Clark & Co.'s ship building yards at Belfast, were furnished in some statistics by George Clark, for the benefit of north Belfast electors a short time ago. Mr. Clark said the firm started ship building in the year 1880 in a small yard, in which they employed about 200 hands, all told. The business had progressed until now they had two large ship yards and an engine works in which they employed between 7,000 and 8,000 hands. During the past 27 years they had built vessels for almost all nationalities, with a deadweight carrying capacity of 1,500,000 tons. The total wages averaged about £400,000 sterling per annum, and if they placed the men in line to receive this money, one pound to each man, the line would extend a distance of five times the whole length of Ireland. The weight of the total wages paid annually, if in gold, would be over 30 tons, and it would take five railway trucks to carry it. These are very interesting figures, and from all appearances they are likely to go on increasing, as Messrs. Workman, Clark & Co. have so much work on hand they have started the preparation of a fifth slip in their south yard.

The former great lakes passenger steamer Iroquois arrived at Seattle recently. She was purchased by the Alaska Steamship Co. and will be fitted with oil-burning apparatus, after which she will be placed on the run between Seattle and Victoria, taking the place of the steamer Indianapolis, which will go on the Seattle-Tacoma run. The Iroquois made the run from New York, via the Straits of Magellan, in sixty days.

The steamer Old Point Comfort, which runs from Cape Charles City, Va., to Old Point Comfort, Va., was recently in collision with the British steamship Barnstable about ten miles inside the Virginia capes. The Barnstable had a large hole stove in her port side and her stem was twisted.

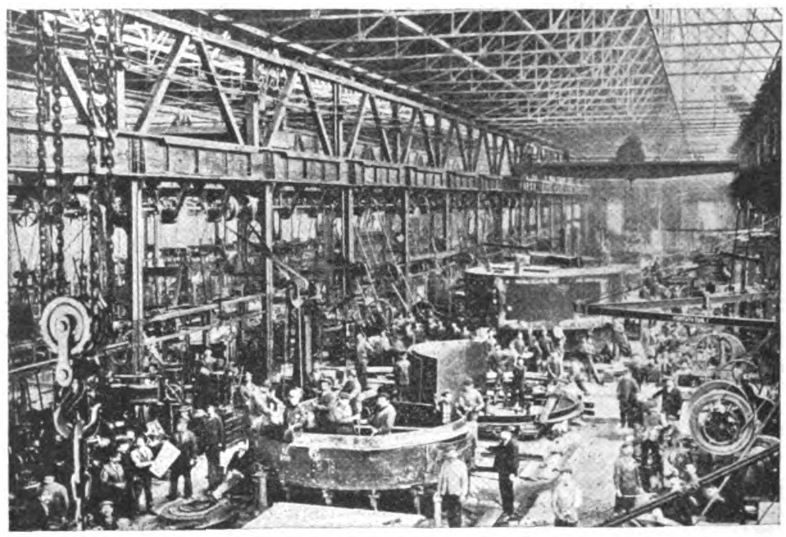


BAY NO. 2, SHOWING PART OF ARMAMENT OF ITALIAN BATTLESHIP REGINA ELENA.

THE ARMSTRONG POZZUOLI WORKS AT NAPLES.

The accompanying photographs are views of parts of the Armstrong Pozzuoli Co., Ltd., works at Naples, Italy.

The principal structure in the works, the large machine shop, is a rectangular building near the center of the grounds, measuring about 460 ft. by 360 ft. and covering about 4½ acres. It contains more than 500 machines, tools of various kinds, and is divided by lines of pillars into eight parallel bays, running east and west, with north lighted weaving shed roofs. Each bay is appropriated to a special department, the arrangement being as follows in order, from north to south: Bay No. 1 is devoted to small calibre ordnance and the production of sighting arrangements. No. 2, the heavy ordnance division, contains boring and rifling lathes, with beds up to 50 ft. in length, which are served by two overhead traveling cranes of 70 tons each. Bay No. 3 contains all the machinery necessary for the production of ordnance of medium calibres, the boring of the inner tubes and hoops of the larger sizes, and that for wire winding on those of any calibre. This can be done at the rate of 1,000m per hour at any required tension, the latter element being susceptible of regulation with the greatest exactitude. The transport service is done by three traveling cranes for 30 tons, 15 tons, and 5 tons respectively. In No. 4 bay, the building of armored shields and turrets is carried on; these parts are usually completed, erected and fitted in the works before being placed on board ship. The heavy work is done by a 50-ton crane, in addition to three smaller ones similar to those of No. 3. The same work is continued in Bay 5. The sixth bay, in addition to containing the heavy planing machines for armor plates, is specially assigned to the construction of gun carriages and mountings, which are erected in Bay No. 7, and also finished in that department. The remaining bay, No. 8 together with some projecting annexes at the west end of the shop, contains the projectile and fuse making departments and the general tool room for the whole works.

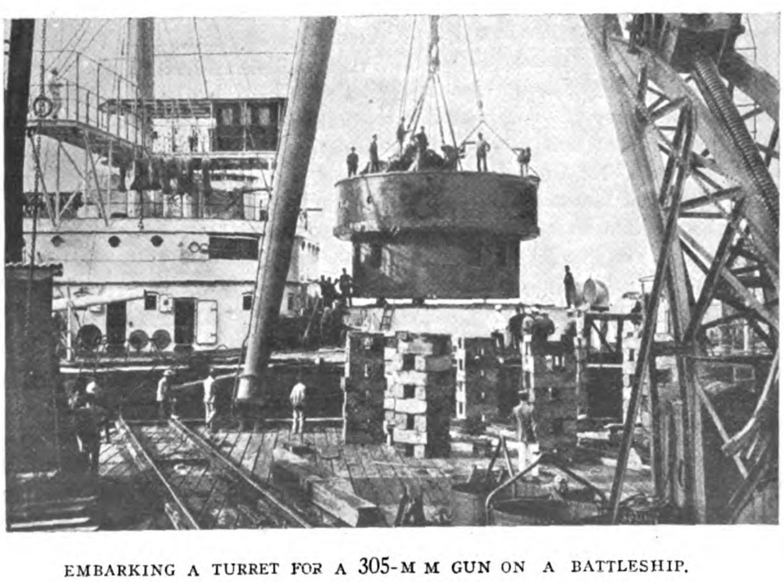


LARGE MACHINE SHOP, BAY NO. 5.

The finishing and inspecting departments for small and medium calibre guns, are contained in a building of about the same length as the main shop, but separated from it by the works railway. Here all the final operations connected with sights and breech actions, polishing, browning, lacquering, etc., are performed.

The hardening and shrinking pits are placed a short distance from the heavy gun bays on the eastern side of the main shop. They include one small and two large pits for shrinking on jacket hoops with two hydraulic cranes for 25 and 15-ton loads, a 200-ton press, two furnaces with rotating beds for heating blooms and hoops, two special furnaces for heating hoops with Bunsen burners, and an oil hardening pit 56 ft. deep.

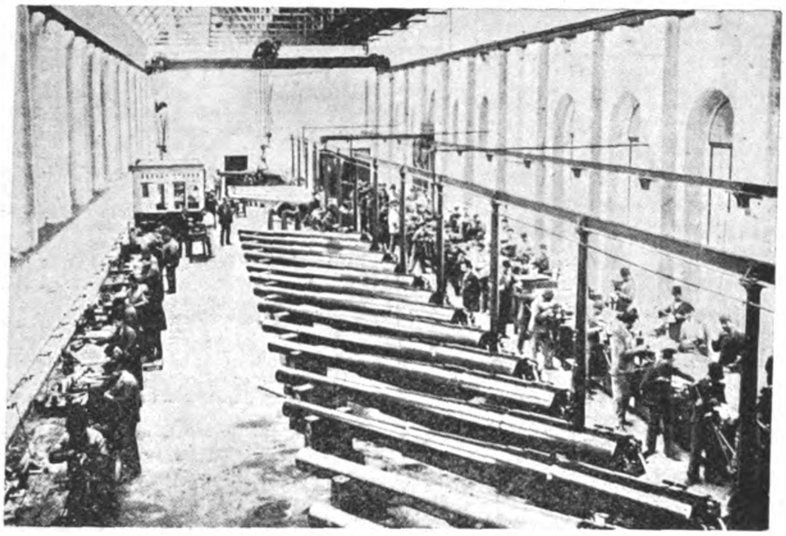
The steel works, placed about 220 yds. west of the principal shop, is a



EMBARKING A TURRET FOR A 305-M M GUN ON A BATTLESHIP.

group of buildings about 650 ft. by 150 ft., covering nearly three acres, and divided longitudinally into three bays. The first of these, adjacent to the railway on the north side, contains four Siemens-Martin steel furnaces on a raised platform 270 ft. long, with a casting pit of the same length on the side, which are capable of producing, when worked in combination, single ingots up to 90 tons weight. A portion of the space beyond the furnaces is used as a steel foundry. The forge in the middle bay contains forging presses of 800 and 4,000 tons with the necessary heating furnaces, pressure pumps, and accumulators.

A third bay on the south side contains the iron foundry and the crucible steel melting shop, which has two gas-melting furnaces each taking eighteen crucibles. The forging presses are served by four traveling electric cranes, two for 100-ton and two for 30-ton loads.



FINISHING DEPARTMENT FOR MEDIUM AND SMALL ORDNANCE.

Beyond the works at the western end is the proving ground, occupying an area of about 18 acres. This contains proof butts, a special mounting for guns under proof, a 10-ton traveling crane, and all the necessary buildings for shelter and chronographic observation. All the different buildings in the works are connected by a standard gage line of railway extending a total length of about 3 miles.

The Armstrong-Pozzuoli works have turned out more than 1,000 pieces of ordnance of different sizes for the Italian and other governments, all the guns having been supplied with the necessary mountings, shields, armor plating, and other accessories fitted for service.

The Skinner Shipbuilding Co., Philadelphia, Pa., has begun the construction of a 221-ft. car float for stock, it being the fourth of the kind to be built by them within a year.

THE BEARDMORE CAPITAINE GAS ENGINE.

Such is the haste of developments in the construction and equipment of war vessels nowadays that obsolete warships are, paradoxically speaking, being produced at a rate all too alarmingly rapid for the burdened taxpayer. The misfortune is that after but a few years' active service when a ship is condemned to obsolescence and is struck off the fighting list, no practical use can be found for her, no matter what her value. Notwithstanding perfect sea-worthiness she is doomed to be sold for an old song to the breakers-up, or to lie idly at anchor, a reminder to the nation of some of its waste millions. This incurable state of affairs does not apply, however, says the *Glasgow Evening News,* to the fate of H.M.S. Rattler, a gunboat of some 750 tons, built in 1885. The vessel has long been, so to speak, on the pension list, a useless and discarded engine of warfare, so hopelessly outclassed would she prove in an engagement with sister ships of later days. At present she lies in a wet dock at the yard of Messrs. William Beardmore & Co., Dalmuir, an object that excites little more than passing interest. Possessing a comparatively good hull, the Rattler was recently procured from the admiralty, and is now being used in connection with an invention that the Dalmuir firm is developing and seeking to perfect. It is well known that for a considerable period there has been conducted at the yards there a series of investigations and experiments upon gas engines as applied to marine engineering. The object of them has been to determine, in comparison with the marine steam engine, their relative value on the particular points of efficiency and economy. The gas engines are of the type known as the Capitaine. Earlier experiments were conducted upon small craft, a launch, etc., which were tried on the Forth and Clyde Canal near by. The collated results were flattering and encouraged the prosecution of further and more elaborate trials. It was officially stated some time ago that the engines had been most successful, not only in economizing of fuel, but also in effecting considerable saving of space in the engine room and its appurtenances. A calculation on the lines of the experimental set of engines showed that approximately 30,000 cu. ft. less space would be absorbed by gas engines, compared with the latest designs of reciprocating engines, with the requisite boilers, etc., on a first-class ocean-going liner. Of itself that was a most encouraging prospect. The coal bill, again, works out a saving of almost 50 per cent on the steam engine. It does not, of course, necessarily follow that statistics obtained from initial experiments will infallibly yield corresponding results under enormously increased developments. Fresh experiments were, accordingly, devised on a much larger scale, involving a more serious test, while modifications and improvements suggested in the design of the engines themselves were effected that are expected to materially enhance their efficacy. It is for the purpose of carrying out the later experiments that the Rattler has been requisitioned. She comes in handily as a goodly-sized craft, and the later design of engines, once they are tested, will be fitted aboard. When all is completed, the vessel will be subjected to a series of exhaustive trials to determine afresh the exact relationship the new method of propulsion bears in economy, etc., to the reciprocating engine. Needless to say, high hopes of conspicuous success are entertained. Possibly in the new idea, it is thought, there may be the germ of a development in marine engineering that may prove as revolutionary as did the turbine to the earlier form of steam engine, and all interested in shipbuilding matters will naturally await the result of the experiments with considerable anxiousness. An interesting feature of the experiments arises from the fact that the Marquis of Graham, who is one of the directors of the firm, is interesting himself largely in their development. The Marquis possesses a valuable association with the marine world, and he is now devoting his attention to the mechanical side, following the experiments that are being made with deep personal interest.

A new stern-wheel steamer for use on the Susitna river, Alaska, is being built at Bremerton, Wash., by F. C. Woolsey. She will have a speed of 14 knots.

LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

In my writings on lake shipyard methods of steel ship construction I only intended touching on the mold work, but I found that it was necessary to explain other parts in order to show the advantages obtained by using the molds.

It seems that I did not give enough

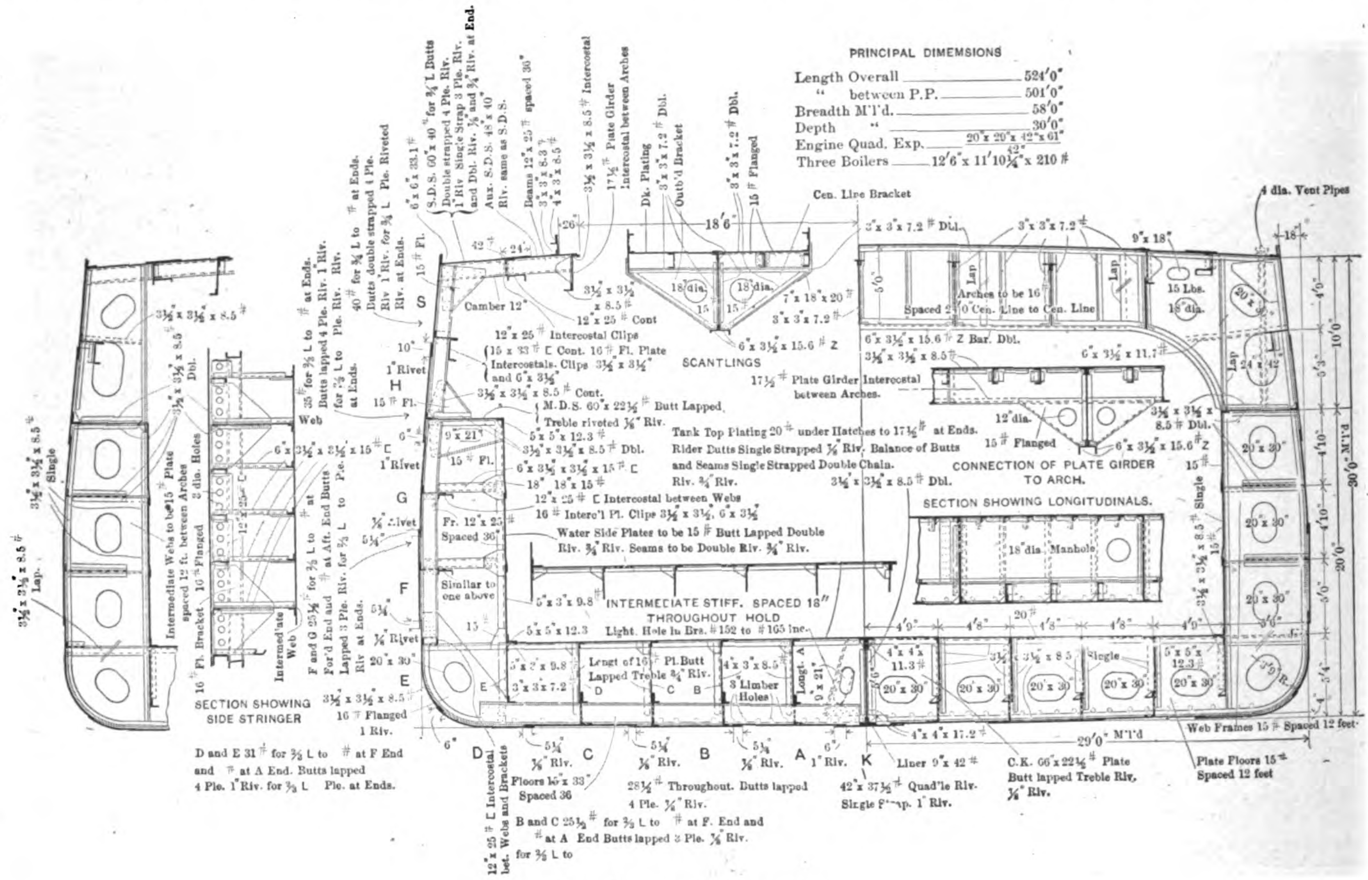


FIG. 1.—MIDSHIP SECTION.

information on the lake methods and that the demand comes for a fuller description of the work.

This I can only do by beginning with the work in the drawing room and explaining every part as the work is proceeded with.

The amount of work necessary to accomplish this can only be appreciated by those who are acquainted with the building of a ship as I have only my spare time to do this work, and limited at that, I was somewhat thoughtful in attempting the task. Talking the matter over with Chas. B. Calder, general manager of the Toledo Shipbuilding Co., Toledo, O., who seems to have the improvement and the bettering of the conditions of the workmen at heart he said he would supply me with any plans I desired in order to continue the subject. I accepted Mr. Calder's offer and will now describe the building of a vessel by that company.

This vessel is now under construction. The dimensions are: Length over all, 524 ft.; length between perpendiculars, 504 ft.; breadth, molded, 58 ft., and depth, molded, 30 ft. She will have quadruple expansion engines 20, 29, 42, and 61-in. cylinder diameters by 42-in. stroke, and three boilers 12 ft. 6 in. by 11 ft. 10¼ in., allowed 210 lbs.

This vessel is built on the arch girder system with straight hopper sides.

Her hopper sides are 5 ft. 6 in. from the skin of the ship, which space is used for water ballast to the main deck stringer, in addition to the ordinary water bottom which is 5 ft. 6 in. deep. The midship section of the vessel is shown by Fig. 1.

The one side shows the web frames spaced 12 ft. apart and the other half the ordinary frame arrangement spaced 3 ft. apart between the web frames. This first plan indicates the cross form of the vessel as well as the scantlings of the various parts. The midship section shows at a glance the specifications in picture form.

The Toledo Shipbuilding Co. is building this vessel on its own account, and the scantlings are in excess of any vessel of her dimensions. On Jan. 3 the MARINE REVIEW published in its shipbuilding edition plans and description of the Toledo plant which might be interesting to the readers of these articles.

When the ship owner contracts with the ship builder for the building of a vessel on the great lakes, it is with the understanding that some other vessel will be duplicated with such improvements as may have been seen which may be advantageous in the handling of the vessel. The duplicating of a vessel saves time in making plans and submitting same to the owner or his naval architect.

The first process in the drawing office is to make a midship section showing all the scantlings and cross shape of vessel as seen by Fig. 1. The sizes of material marked on this plan determine the same for at least two-thirds the length of the vessel amidships. The main frame spaced 36 in. apart is composed of 15 in. 33-lb. channel floor 16-lb. flanged center keelson bracket plate with double angles 3½ in. x 3½ in. x 8½ in. Longitudinal stiffener angles 4 in. x 3 in. x 8½ lb. with 15-lb. bracket plate on top, 16-lb. bilge bracket plate flanged on edge with 3½ in. x 3½ in. x 8½-lb. frame angle extending from the bottom to top of plate, top side frame 12 in. x 25-lb. channel in two pieces extending from the line of tank top to spar deck, cut and bracketed with 15-lb. flanged plate to the main deck stringer plate.

The top part of the frame is connected to the beams with a flanged plate 15 lb., the same thickness as the bracket at the bottom, connecting the frame to the main deck stringer.

The clips riveted to the frame for in-

tercostals are all 3½ in. x 3½ in. x 8½ lb. with the exception of the clips on the flange side of the channels which are 6 in. x 3½ in. x 11.7 lb. to take the intercostals which are cut to the edge of the flanges of the channels.

The web frames are spaced 12 ft. apart and are composed of 15-lb. plate and 3½ in. x 3½ in. x 8½ lb. angles and are 66 in. wide extending from the keel to the spar deck.

Every 24 ft. the web forms a belt as shown by the midship section, the top or deck part being termed the arch. This arch is composed of 16-lb. plate 60 in. deep and spaced 24 ft. apart. The deck angles are double 3½ x 3½ x 8½ lb. and the bottom of the plate is stiffened with Z bars 6 in. x 3½ in. x 15.6 lb.

The web frames are in three pieces, the bottom part being termed the plate floor which runs from the center keelson to the bilge, being scored out at the girders to allow the girders to pass through whole.

The side part of the web is riveted to the floor part in line with the tank top and extends to the main deck line and is connected to the main deck stringer with double angles 3½ in. x 3½ in x 8½ lb. The top plate is riveted to the spar deck beams at top and the bottom is connected to the main deck stringer plate with doubles 3½ in. x 3½ in. x 8½-lb. angles. The web at side is shown on plan as intermediate webs and are spaced 12 ft. apart. Every 24 ft. the arch plate is lapped on to the inner edge of the web as shown on midship section above the main deck line.

The spar deck beams 12 in. x 25 lb. channel between the hatches are run from side to side in one piece and at the openings the beams are connected to the intercostal girder with plate brackets, 15 lb., and flanged to girder plate.

The center keelson is composed of 22½-lb. plate 66 in. deep with double angles top and bottom. Top angles 4 in. x 4 in. x 11.3 lb., bottom 4 in. x 4 in. x 17.1 lb. The longitudinals in the bottom are continuous, of 16-lb. plate and in one piece from the top of floors to tank top plating, being scored out for the tank top plating stiffening angles. The bottom angles are continuous and top intercostal 3 in. x 3 in. x 7.2 lb. The top angles on the E girder are 5 in. x 3 in. x 9.8 lb. to suit the rivet holes for the bottom angle of the water side plating. The tank top plating under the hatches is 20 lb. and 7½ lb. at the ends. The stiffeners under the plating are 4 in. x 3 in. x 8½ lb. and spaced 18 in. apart.

The waterside plating is 15 lb. and stiffened with angles 5 in. x 3 in. x 9.8 lb. spaced 36 in. apart, braced to ship side with channels 6 in. x 3½ in. x 3½ in. x 15 lb. and 15 lb. bracket plates. The top and bottom angles are 5 in. x 5 in. x 12.3 lb.

The intercostals in line of tank to shell plating are 12 in. x 25 lb.

Side stringers between tank top and main deck are 12 in. x 25 lb. channels intercostal between web frames and connected to same with 16 lb. flanged bracket plates.

The main deck stringer plate is 66 in. x 22½-lb. and connected to shell plating with continuous angles 3½ in. x 3½ in. x 8½ lb.

The top angle of the waterside plating is connected to the main deck stringer, forming the top of the water bottom at the side.

The side stringer between the main and spar deck is continuous, of channels 15 in. x 33-lb. and connected to the shell plating with flanged intercostal plates, 16-lb.

The spar deck stringer is composed of two plates in width, 60 in. x 40-lb. and 48 in. x 40-lb. edge and edge connected with a continuous strap 24 in. x 42-lb.

The stringer angle is of 6 in. x 6 in. x 33.1-lb. Along the hatch openings is fitted an intercostal girder plate 26 in. x 17½-lb. with angles 3½ in. x 3½ in. x 8½-lb., and connected to arch plates with bracket, 15-lb. and flanged on edge. The girder, where scored out, is connected with angles 6 in. x 3 in. x 11.7 lb. on one side and 3½ in. x 3½ in. x 8½-lb. on other side of beam. The spar deck plating is 12½-lb. and runs across the ship from stringer to stringer and is lapped on the arch plate deck angle. Under the spar deck, between the hatch opening and ship's side are channel girders 12 in. x 25-lb.

The hatch coamings are of 15-lb. plate, stiffened on top with angles 4 in. x 3 in. x 8½-lb., and connected to the deck with 3 in. x 3 in. x 8.3-lb. angles.

A MOTOR CRUISING YACHT FOR RUSSIA.

A vessel of a very interesting type has recently been ordered of Messrs. John I. Thornycroft & Co., Ltd., of Chiswick, a type indeed, which should be of the greatest service for a river such as the Volga, for which this particular boat is destined. The accommodation provided is essentially for a private party. The unique experience of the designers and builders is made evident in the convenient manner in which the various compartments are arranged, both fore and aft, leaving the maximum of floor space, and headroom. This is in marked contrast to the cramped accommodation usually available in either steam or motor yachts of a similar size. The dimensions of the boat are as follows: Length, 70 ft.; beam, 13 ft.; draught, 2 ft. The hull is of Seimens-Martin steel, galvanized, and the woodwork throughout is of teak. Forward is a commodious saloon with dining table, chairs, two side boards, and cushioned seats. Immediately aft of this are two single berth cabins each with folding lavatory, cushioned seat, etc. Following these on the starboard side is the toilet room, with large bath, etc., and on the port side pantry with sink, dresser, ice-chest, and other fittings. The companion from these compartments leads to the upper deck.

Access is gained to the galley, which is between the owner's compartments and engine room by a separate hatchway from the deck. From this a serving window communicates with the pantry. A cooking stove ample for the requirements of fifteen or twenty persons, with coal bin, dresser and shelves is provided in this apartment, the smoke and fumes from the stove being led away to the main funnel over the motor room. The latter occupies a floor space only about 12 ft. 8 in., and contains two sets of motors driving twin screws. Fuel tanks of sufficient capacity for a run of about 12 hours at full speed are fitted on either side of the motor room under the deck.

Aft of the motor room is a second saloon with settees at either side, writing cabinet, table and chairs. This leads into a passage, on one side of which is a second lavatory, and on the other a store room and cupboard. The crew space is situated right astern, and contains seats, lockers, etc.

The upper deck with a canvas awning overhead forms a very roomy promenade, and has sparred seats (with fresh water tanks underneath each) on either side of the boat, forward.

The steering wheel and engine room telegraph is also on this deck.

The motors are of the well-tried Thornycroft six inches by eight inches four-cylinder type, using paraffin exclusively, and developing together about 100 B. H. P. on this fuel. They have magneto ignition. The controlling gear is very conveniently arranged, so that both engines may be easily controlled by one person. Their working parts are all of ample dimensions, durability thereby being ensured.

The design and construction of the motors generally have been carried out with a view to securing an efficient and reliable engine for ordinary commercial or private service eliminating to the greatest extent risk of breakdown.

The reversing gear is of the new and improved Thornycroft "C" type, which possesses considerable advantages over anything hitherto produced for marine purposes.

The exhaust from the motor is led up to a silencer fitted at the base of the funnel, which carries off any fumes well above the awning. There is thus no likelihood of inconvenience from this source.

The speed guaranteed is twelve miles per hour. This will be comfortably attained by the motors at an economical rate of revolutions.

Generally speaking the boat is a sound and handsome looking vessel, and in view of the moderate initial cost, economy of working, and more particularly its suitability for passenger traffic on rivers or sheltered waters, it is likely to find favor in many parts of the world.

TRIAL OF STEAM YACHT AMERICAN.

The steam yacht American, designed and built by the late Commodore Archibald Watt, had a trial trip on April 18 on the Long Island sound, from Execution light to Middleground, a distance of 31 knots. The American is now owned by Miss Grace Watt, a sister of the late commodore, who entertained a party at luncheon. The engine and boiler plant consists of two triple-expansion steam engines of about 1,200 I. H. P. each, with cylinders 19, 30 and 45 in. in diameter by 26-in. stroke. The engines were designed and built by the late commodore, and his chief engineer, Mr. Hinds. The valves, valve gear and reverse engine, which are of the Seabury type, were designed and built by the Gas Engine & Power Co., and Charles L. Seabury & Co., Consolidated, Morris Heights, New York city. The boilers, which are of the Seabury watertube type, were built by the latter company. Two runs were made, one on natural draft, and one on forced draft. Both runs went off very successfully, the engines worked smoothly, with little vibration, and no bearing showed excessive heat. The boilers were efficient and easy to work.

First trial, under cruising conditions and natural draft:

Speed, 12½ knots; average steam pressure, 150 lbs.; average revolutions, 121; I. H. P. of two engines, 1,500.

Second trial, under forced draft:

Speed, 15 knots; average steam pressure, 164 lbs.; average revolutions, 138; I. H. P. of two engines, 1,850.

Joseph R. Oldham is in Cleveland to supervise the fitting out of the steamer A. G. Lindsay for salt water service. A condenser, evaporator and distiller will be installed and new decks and hatches put in. The Lindsay was purchased by the Rupert Steamship Co., of Aberdeen, Wash.

EARNINGS OF CUNARD.

The financial statement of the Cunard Steamship Co., for the year ended December 31, 1906, was issued recently.

The balance sheet shows 60,000 full-paid £20 shares and 40,000 £10 paid shares outstanding; government advances of £1,999,004 and bankers' acceptances of £660,000 against new ships (the company issued £2,600,000 2¾ per cent debentures to be made to the government against such advances); and other creditors £301,627. The book value of the fleet is given as £3,481,657, or $95.47 per ton for 182,345 gross tons. Amount paid on account of the Lusitania and Mauretania, building (each 33,000 tons), is £1,579,625.

Following is the income account:

	1906.	1905.	1904.
Gross earnings	$11,350,080	$8,866,340	$7,443,800
Net	2,765,965	1,540,915	307,940
From reserve..	....	....	375,000
Other income..	20,400	32,995	65,235
Total income.	$ 2,786,365	$1,573,910	$ 748,195
Prev. surplus..	36,425	37,154	27,890
Total	$ 2,822,790	$1,611,055	$ 776,065
Depreciation ..	1,098,910	910,305	699,460
Inc. tax, ins. etc..	201,820	94,321	39,450
Dividends (5 per cent)	400,005	†320,004	....
Reserve	250,000	250,000	....
Insurance fund*	600,000	....	....
Surplus	$ 272,055	$ 36,425	$ 37,145

* Further amount set aside. † 4 per cent.

Insurance fund now stands at $2,500,000, against $1,900,000 a year ago, and reserve fund at $1,000,000 against $750,000.

THE SUEZ CANAL.

Statistics of the traffic during the last three years have been issued by the Suez Canal Co., and permit of a comparison between the years 1904—the last with the old rate of 8f. 50c. per ton—and 1906, the second with the reduced rate of 7f. 75c. The total tonnage in 1904 was 18,661,092 tons gross, and 13,401,835 net; and in 1906, 18,810,713 gross and 13,445,504 net. The British tonnage declined from 12,164,591 tons gross and 8,883,929 net to 11,493,279 and 8,299,931 tons respectively in the two years.

Germany and France, which follow next in order, show an appreciable increase; Germany from 2,736,067 tons gross and 1,969,561 net to 3,022,512 gross and 2,155,552 net; France from 1,167,105 gross and 777,742 net to 1,286,125 gross and 856,311 net. The number of British ships that passed through the canal also fell from 2,679 to 2,333 in the two years, while the German rose from 542 to 588; and the French remained almost stationary with 262 in 1904 and 260 in 1906. Holland, which occupies the fourth place, was also on the down grade, having receded from 223 ships, 814,204 tons gross and 582,967 net, to 202 ships, 791,308 tons gross and 561,322 net.

There was a large increase in the movement of Russian shipping in 1906 on 1904, due to the end of the war. From 82 ships, 249,801 tons gross and 153,848 net, in 1904, it rose to 113 ships, 468,026 tons gross and 330,375 net, in 1906. The American flag also improved from 17 ships of 39,220 tons gross and 24,436 net to 22 ships of 106,072 tons gross and 67,876 tons net in 1906.

The other countries showing an increase of tonnage were Austria-Hungary, Denmark, nearly double, Japan, from 6 ships of 32,813 tons gross and 21,463 net, to 37 ships of 209,163 tons gross and 147,279 net in 1906. No Japanese ship passed through the canal in 1905. Turkey and Portugal also obtained an increase in 1906 on 1904, but Egypt, Spain, Greece, Italy, Norway, and Portugal marked a decline on the two years.

The total number of ships of all flags was 4,237 in 1904 and 3,975 in 1906, the former having been a record year. The number and percentage of new ships that passed through the canal for the first time also fell from 377 ships and 23.9 per cent of the total in 1904 to 246 and 20.4 in 1906. In that respect the best of a series of years was 1900, when 360 new ships and 27.6 per cent used the canal. There was an increase on the tonnage of the ships in 1906 compared with 1905; in the former year 828 per thousand had a draught of 7.50m. or under, and 172 above; in 1906 the proportions per thousand were 797 and 203.

PROPOSED PORTUGUESE SUBSIDY.

The following is a translation of the proposed law for the establishment and subsidizing of a Portuguese line of steamers to Brazil:

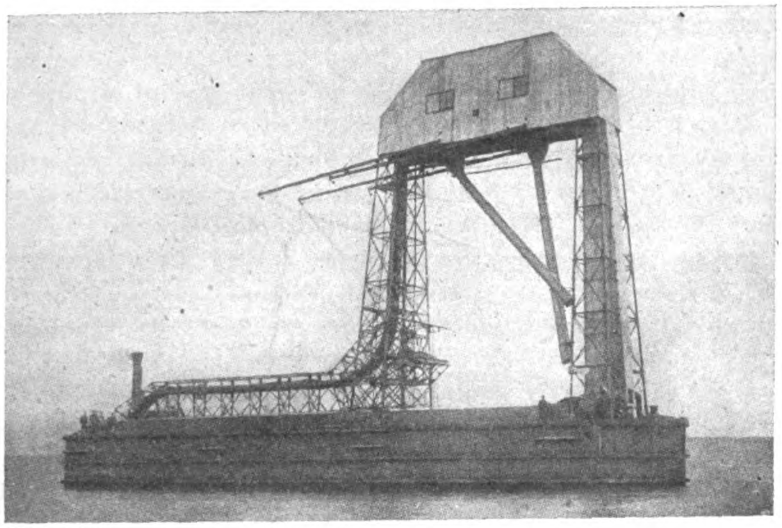
The government is empowered to grant an anual subsidy not exceeding 444,000,000 reis ($242,424 American currency) for the period of fifteen years to the joint stock company which shall be constituted to perform regular voyages between the ports of Portugal and those of the United States of Brazil, in conformity with the bases annexed to the present law, of which they form an integral part.

(a) For the granting of the subsidy a public competition shall be opened for the term of three months.

(b) When the profits shall allow of the distribution of the proceeds of a dividend exceeding 6 per cent a moiety of the surplus profits shall be deducted from the subsidy. If exceeding 8 per cent, two-thirds of the surplus shall be deducted from said dividend.

THE CLARKE AUTOMATIC COALING BARGE.

Since the introduction to Mersey shipping of the Clarke system of automatic coaling barges, which by the way is an American invention, remarkable progress has been made both in the provision of additional coaling barges, and also in the general adoption by Liverpool shipowners of this system which has almost wholly displaced the antiquated one of coaling huge liners by hand. There are now two types of coaling barges used in this system, one for coaling "over all" and the other for coaling through side ports, the fleet at present consisting of five such barges, with a capacity of about 1,300 tons each, while others are in course of construction or their building contemplated.



CLARKE AUTOMATIC COALING BARGE.

P. B. Clarke, the inventor of the new type of automatic coaling barge, has endeavored to meet all the conditions required for the expeditious and economical coaling of vessels. Hand coaling having been complained of as too tedious and expensive a process to continue, he has invented an automatic system for which several advantages are claimed, economy, rapidity, ability to handle any kind of coal, freedom from the dust nuisance, mobility (so that the coaling can be done whether the ship is in dock or in the river) ability to do the coaling at night (so as to prevent interference with the handling of cargo in the day time) and automatic weighing and self-registration of weights.

The Clarke barge can be briefly described as resembling a floating grain elevator, from whch the coal is automatically tipped into adjustable chutes running down to the deck bunker hatches or the side coaling ports of the ship as the case may be. The entire operation being automatic and continuous, apart from the engineer and crew one man can work the barge in actual coaling operations and the coal can be put into the bunkers of the ship at the rate of 180 tons an hour for each barge. The coal is just tipped into the barge in the ordinary way, the barge being provided with a false bottom, and between that and the keel bottom a space is arranged along which runs a continuous chain of endless buckets. There are a number of sliding doors in the false bottom through which the coal drops into the buckets. The latter are carried perpendicularly up to a self-acting and self-registering weighing machine and the coal after being weighed in ¼-ton lots is automatically tipped into adjustable chutes running down to the hatches or into the coaling ports of the ship as the case may be. In a recent test with H. M. S. Vengeance 904 tons of coal was put on board by two of Clarke's barges in 4¾ hours, but if a sufficient number of trimmers had been available this could have been easily reduced to 3½ hours. On board the Vengeance the opinion was freely expressed that the barges represented the finest mechanical coaling appliance the officers and crew had ever seen.

SAILORS' NICKNAMES.

The Mallory Steamship Lines have just put out a folder which is replete with a variety of interesting information in addition to sailing dates and places reached. Most of it is very good reading. For instance consider these definitions of sailors' nicknames:

Blue Noser.—A Nova Scotia seaman.

Bucco.—A bullying ship officer.

Crimp.—A dishonest shipping-master.

Dago.—A Portuguese or Spanish sailor.

Davy Jones.—A mythical sea devil.

Dickey.—A term for the second-mate.

Doctor.—The ship's cook.

Jock.—A Scotch seaman.

Jack-Nasty-Face.—The cook's helper.

Jimmy Squarefoot.—The devil.

Johnny Crapaud.—A French sailor.

Johnny Newcome.—A novice on ship board.

Johnny Raw.—A green hand.

Jonah.—One bringing ill fortune.

Lime Juicer.—An English seaman.

Nurse.—A nautical teacher.

Sea Lawyer.—An arguing sailor.

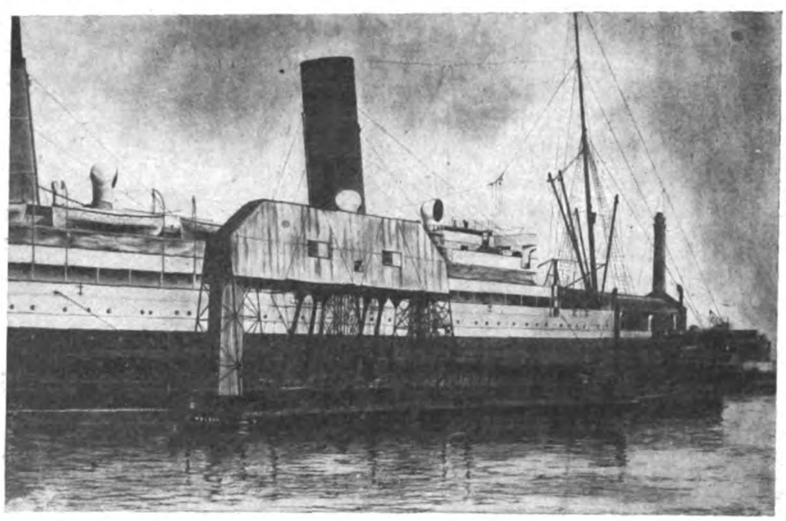
Shark.—A dishonest individual.

Ship's Husband.—A vessel's manager.

Sky Pilot.—A minister of the gospel.

Swab.—A worthless member of the crew.

Top Sawyer.—A leader among the crew.



THE COALING BARGE ALONGSIDE A LINER

The New England Co., Bath, Me., has been awarded a contract for a large four-masted schooner for the Benedict-Manson Marine Co., Bath, Me.

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May 2, 1907.

NEW APPRENTICESHIP SYSTEM.

The MARINE REVIEW in the March engineering issue, published an article by H. Bithel-Jones on the training and education of the foreign marine engineer. In this article a good insight was given of the systems adopted in the various countries, the author regretting the deplorable practice in England of letting the apprentice drift through the five years term, learning just as much or as little as he cares to. No promise is given to teach the boy, who may leave whenever he cares to, and who may be dismissed whenever the employer thinks fit. The only guarantee that the majority of employers will give is that as long as the lad behaves himself and attends regularly he will be kept in the works.

The system now being adopted by Messrs. Clayton and Shuttleworth, wherein the heads of departments take a personal interest in the apprentices under their charge, will, as intended, produce a much superior class of mechanics, skilled in the use of brain as well as hands.

An apprentice on this side of the water has not so much chance of "drifting" through the work as he has in England, being much higher paid and accordingly having more expected of him. It is a case of "work, or get out." In England, where the average weekly wage of the apprentice is about $2, an apprentice has to be incorrigibly bad to suffer dismissal. The usual punishment for misbehavior being a period of temporary suspension averaging from one to four weeks. This lost time has to be worked up at the completion of the five years' apprenticeship, when the apprentice is doing the work of a machinist, on the pay of an apprentice in his last year. It is then that the works reap the benefit of the early misdemeanors of the apprentice.

The educational part of the system cannot be spoken of too highly, as it not only improves the apprentice in the machine shop technically, but affords the superintendent the opportunity of distinguishing between the apprentice machinist and the apprentice desirous of adopting engineering as a profession, and handle each according to his individual needs. Heretofore an apprentice could excuse his non-attendance at technical schools by his inability to pay for the necessary books and instruments, but as Clayton and Shuttleworth have generously provided the schooling and utensils, it is up to the apprentice to gratefully respond, and we can only await results with interest.

THE ENGINEERING SOCIETIES BUILDING.

Through the generosity of Andrew Carnegie, the great engineering societies of America are now housed in a magnificent union building located at 29 West 39th street, New York City. The past two weeks have witnessed the dedication of this structure, known as the United Engineering Societies Building, and of the Engineers' Club, adjacent on 40th street. The centralization of the general offices of these national organizations in one great building, with ample auditorium and library facilities, has been the dream of engineers for more than a score of years, but it was not until the project was broached to Mr. Carnegie by President Scott, of the American Institute of Electrical Engineers some six years ago that the project gave promise of realization. Following a dinner at which the plan was proposed, Mr. Carnegie called a number of prominent engineers to his home, and, after a conference, announced that he would give $1,000,000 for this object. This gift was later increased to $1,500,000. Of this amount, $1,050,000 was set aside for the erection of the United Engineering building, $450,000 being designed for the erection of the club, the members of which later added about $175,000. In the case of both buildings the site was provided by the engineers.

The contract for the building of the structure was closed with Wells Bros. Co., July 17, 1905, the cornerstone laid by Mrs. Carnegie, May 8, 1906, and the building now stands, occupied, thirteen stories high and almost 220 feet from the street level—truly a magnificent feat in rapid construction.

The ground floor consists, principally, of a great central columned court, finished in marble. Facing the doorway, impaneled, are two bronze tablets, one of them, bearing beneath a fine bas-relief of Andrew Carnegie, the following brief letter to the three founders societies and the Engineers' Club:

"It will give me great pleasure to devote, say $1,500,000 to erect a union for you all in New York City. With best wishes, very truly yours, Andrew Carnegie."

The other tablet has the following inscription:

"For the advancement of the art and science of engineering. The site presented by members and friends of the American Institute of Electrical Engineers, the American Society of Me-

chanical Engineers, and the American Institute of Mining Engineers."

The auditorium with its gallery extends up through two floors, is designed for the general meetings of the societies, and has a seating capacity of about one thousand. Seven lecture rooms of various sizes occupy the two floors directly over the auditorium, and are so arranged that audiences from one to ten hundred can be accommodated. The seventh and eighth floors of the building have been reserved for associate societies having engineering or other departments of science for their principal object, the offices being of sizes and design to suit the requirements of each individual body. The headquarters of the Society of Naval Architects and Marine Engineers are in this section.

Each of the three founder societies will occupy a floor, the design of which will suit its own particular needs. The American Institute of Mining Engineers has the ninth floor, the American Institute of Electrical Engineers the tenth floor, and the American Society of Mechanical Engineers the eleventh floor. The twelfth and thirteenth floors have been reserved for the libraries and engineering literature of the three founder societies.

FREIGHT SITUATION.

The ore movement during April last year was 1,447,386 tons, but it is doubtful if this year it will exceed 250,000 tons. The weather on Lake Superior is quite disagreeable, cold winds prevailing, and is delaying the movement of ore from the mines. The stock piles are frozen and the ore is frozen in the pockets. In fact, up to Tuesday of this week only nine boats had cleared with cargoes and it will probably be a week yet before the season is actively under way. Naturally there is congestion at upper lake coal docks owing to the fact that a fleet of nearly seventy-five vessels was locked through the canal one after the other. It will probably be a week yet before they are all worked out. For this reason there has been no special rush in loading cargoes at lower lake ports during the present week. Small coal carriers are in good demand and profitable rates are offered to the smaller ports. The fleet which has been trying for several days past to get into Fort William has, at last, succeeded, though ice conditions were severe. The ice crusher

bines; but for a freight packet give me the good old common-sense power.

Currie—These are very comfortable boats, and also very economical ones. With these we move freight cheaper per ton-mile than they do anywhere else in the world.

Saunders—Let us go aft and size her up.

(They proceed to the engine room.)

Saunders (as he casts a critical eye over the outfit)—She looks good. But trot out your crew and let's see her turn.

Currie—I have no crew.

Saunders—What! No crew? It looks to me as if you are nearly unloaded.

Currie—My crew was sent out on another boat of the line this morning. Through some mistake of the shipping-master the matter of obtaining a new crew was delayed. But they will be here at 5 o'clock and we sail at 6.

Saunders—Yes, you will; ship a new crew at 5 and sail at 6. Dan, I'm not lotty yet. I've not sailed around the world five times for nothing. I know what the matter of breaking in a new

naces crownsheeted. Then you'll have no steam, three or four hot connections, and there'll be something doing around the engineer. No, no, Dan! Take my advice and don't attempt it. Notify your manager, while there is yet time, that you can not leave until your crew is broken in. Ask him to give you forty-eight hours in order to get them knocked into some sort of shape.

Currie (leaning comfortably back in his chair, and reaching for a fresh Havana)—It doesn't worry me a bit.

Saunders—Sufferin' cyclones! Have you invented some new way of running steamboats?

Currie—It's not my invention. But, as you remarked a while ago, all these boats look alike. Now let me tell you that some time ago we reached the limit to the size of boats on these lakes. Since then only the maximum size has been built, and the others soon became obsolete. After we had standardized our boats, our next step was naturally to standardize the machinery. On all the

d[illegible] pig iron market. During the past week there has been sharp advances in quotations in all sections of the country. Reports to the Eastern Pig Iron Association indicate furnaces sold up five or six months in advance and in the valleys, Buffalo, Cleveland and Chicago districts the available supply for the remainder of this year is very small, some furnaces having sold their entire estimated product up to Jan. 1, 1908. In view of the strong demand and the heavy orders on hand, it would appear that higher prices are inevitable. A shortage of semi-finished material has also shown itself. The sale of over 75,000 tons of crude steel for last half delivery exhausts the estimated production of one of the largest independent producing interests for the remainder of the year on billets and sheet bars. The railroads are showing a hesitancy to placing rail orders for 1908 delivery, that is rather disappointing to makers. Plates are holding to their present strong position.

AROUND THE GREAT LAKES.

The MARINE REVIEW would like to ascertain the whereabouts of William Potter, a lake mate.

The largest grain cargo ever carried by a vessel on the lakes was loaded at Duluth on the steamer W. B. Kerr this week for delivery at Buffalo. It consisted of 402,000 bushels of wheat.

The new dry dock of the Toledo Ship Building Co. at Toledo was placed in commission on Monday, the little passenger steamer Lakeside being the first boat to occupy it.

Charles A. Hoyt has been appointed

Capt. Frank B. Higgie has been appointed vessel dispatcher at Chicago by Mayor Busse. Capt. Higgie is the head of the well known vessel agency of F. B. Higgie & Co., with offices in the Rialto building.

The Great Lakes Towing Co. is putting a new wheel on the tug S. C. Schenck in its floating dry dock at Cleveland. As soon as repairs are completed the Schenck will leave for Ogdensburg and tow a dredge from that port to Duluth.

The Hamilton Steel & Iron Co. is remodeling its ore dock at Point Edward. The McMyler Mfg. Co. of Cleveland is installing two revolving locomotive cranes, each operating a 3-ton bucket with a capacity for discharging 150 tons per hour per bucket. The cranes travel on a 16-ft. gage track.

The Akers Steering Gear Co., Chicago, Ill., has secured a contract for the installation of its hand emergency gear on the car ferry Ontario No. 1, recently launched from the Toronto yard of the Canadian Ship Building Co., and of which a description will be found on the first page of this issue.

Capt. W. C. Richardson of Cleveland has sold the steamer J. H. Devereaux to Capt. Woodside of San Francisco. The Devereaux was built by the Globe Ship Building Co. at Cleveland in 1885 and is 243 ft. keel and 37 ft. beam. It is the purpose of her new owners to operate her in the oil trade on the Pacific coast, and she will consequently be converted into an oil tanker.

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ERVICE"

to slow down to nearly stopping point, and as suddenly they dived through the engine-room door and sprang down the ladders. Quick as they were, the chief and first were at their heels, betraying the fact that the close proximity of the Grand Mogul disturbed their slumbers. Perhaps it wasn't so, who can say.

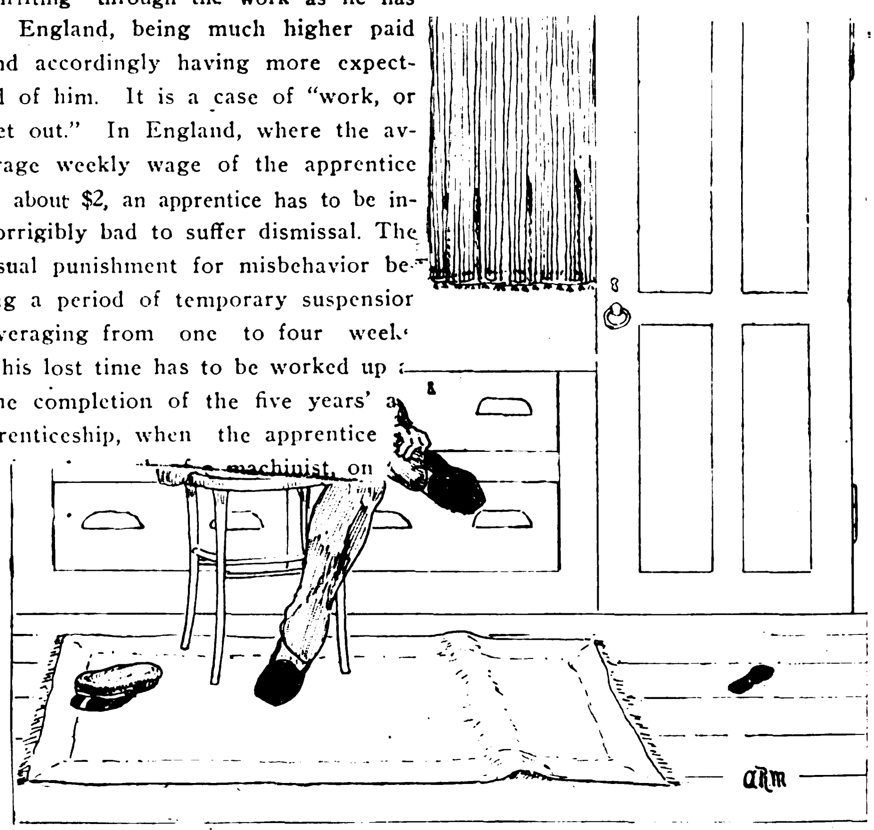
On the starting platform the second stood with his hands on the levers, peering up at the mass of machinery, trying to locate a dull thumping sound proceeding therefrom, as he shouted orders to his assistants and oilers. The work in the boiler-rooms had been suspended when the fans were slowed down, and the steam, which they had striven so hard to keep at the top notch, was simmering up the escape pipes. It was some little comfort to know that the hour prevented the Grand Mogul's crowd from seeing her blow off, awaken to the fact that there was trouble on the Inverkeld, and gloat accordingly. "Man's inhumanity to man."

The engineers darted round the slowly revolving engine, trying to find the cause of the slight shock accompanying each revolution. The trouble lay not in finding where the unusual jar was, but in finding where it was not. The same pounding could be heard at each cylinder, crosshead, and crank, or so it seemed, each man positively finding the trouble on the average of every quarter minute.

An oiler finds that the intermediate crank pin is heating up rapidly and the bearings on each side of the pin, and hurriedly reports to the second. will have to be a hurried, but none the less thorough, job. The handiest firemen are pressed into service, assisting the oilers in rigging up the chain-blocks and other gear. The men and engineers are divided into gangs, each tackling a part of the engine. The caps of the bearings come off, engines turned over to examine the shaft, and the caps lowered into place. The trouble is not there. In turning the engine over it is found that she hesitates when the intermediate crank-pin is turning the bottom center—sticks a trifle, in fact—so the gang at work on the nuts of the lower cylinder plug are urged to rush things still more.

The Grand Mogul, receiving no distress signals from the Inverkeld, has forged away ahead, leaving her ill-fated rival still farther in the rear. The captain has a bulletin bearer continually traveling between the chart-room and engine-room, and on the bridge the mates, who have been enthusiastically noting the dogged, untiring speed of the mass of steel beneath their feet, softly curse the luck as they realize their helplessness.

The nuts being at last slackened off, the engine is turned over and the great plug lowered. A cable lamp is pushed up into the cylinder, and the first, with many warnings from the "old man"



HE GAZED PENSIVELY AT THE BOLT, THE CAUSE OF THE TROUBLE.

and his assistants to be "careful," climbs gingerly on the plug and rises into the cylinder. A few seconds of suspense and a muffled voice announces the end of the search. A liner bolt lies displaced and slightly flattened at the bottom of the cylinder. The bolt is passed out and handed round as the first examines the remaining bolts preparatory to descending from the cylinder. The plug is again run into position, nuts tightened up, and all the gear cleared away.

"Stand Clear" rings through the engine room, and a second later the answering "All Clear." The engines gently turn the center back and forth a few times, responding to the "Old Man's" hands on the levers, then swing ahead, gradually gaining speed. In a few minutes she is again full ahead, with no sound beyond the regular rythmic beat, the 12-to-4 "shaking her up" to the limit.

An "All right, boys" from the chief, sends the engineers in a hurry up the ladders to the deck, where they make

sundry remarks in the direction of the stern light of the Grand Mogul, far, far, ahead. The First, sitting in his room, listens to their conversation, and as his eyes fall on the bolt, the cause of the trouble, he snorts again.

THE "STAND-BY" MAN.

NOT YET, BUT SOON.

A DIALOGUE.

BY JAMES ROSSEN.

Scene—The lake front at Cleveland. A large 10,000-ton freighter is moored at the dock with the huge clamshells busily digging out the ore.

The time is 4 P. M., Dan Currie, the chief engineer, is sitting beneath the awning with his feet cocked up on the railing. He is emitting clouds of smoke from a fragrant Havana and presenting a picture of perfect contentment.

Suddenly a man intrudes on the peaceful scene, slaps Currie familiarly on the back, and the two men grasp each other's hands in friendly greeting.

Currie—Well, well, Saunders, it's a pleasure to see you! Now sit down and tell me where you have roamed these last ten years.

Saunders—Sure, it's a pleasure to be back home to the lakes again. They say there is a magic about these lakes which always draws its native sons back sooner or later. And I believe it. Why, man, I've been around the world five times. I've sailed in anything from a frying-pan to a floating hotel. I've yanked throttles on pretty near everything from a 1-H. P. gasoline motor to a 10,000-H. P. quad. I've fought the impulse to come back to the best of my ability. But a week ago, when I landed in Boston, it got the upper hand of me and I had to come.

Currie—Yes, they all come back; and it's not a bad place to come to either.

Saunders—To judge by your appearance, I should say not. The stamp of happiness and prosperity is written on your face.

Currie—I have a good job.

Saunders (looking about him)—Pretty nifty bit of a craft you have here, Dan. And I see a lot of others looking exactly like her in the slips around here. I suppose it's a big concern with a vast fleet?

Currie—No, they all have different owners.

Saunders—You don't say. I thought they looked so much alike. What have you aft, Dan? I suppose she's the regulation, three Scotch kettles with 200 lbs. and a 24-in. triple.

Currie—You've guessed it exactly.

Saunders—Yes, those are the most sensible plants. You can talk about your highfalutin' watertubes and turbines; but for a freight packet give me the good old common-sense power.

Currie—These are very comfortable boats, and also very economical ones. With these we move freight cheaper per ton-mile than they do anywhere else in the world.

Saunders—Let us go aft and size her up.

(They proceed to the engine room.)

Saunders (as he casts a critical eye over the outfit)—She looks good. But trot out your crew and let's see her turn.

Currie—I have no crew.

Saunders—What! No crew? It looks to me as if you are nearly unloaded.

Currie—My crew was sent out on another boat of the line this morning. Through some mistake of the shipping-master the matter of obtaining a new crew was delayed. But they will be here at 5 o'clock and we sail at 6.

Saunders—Yes, you will; ship a new crew at 5 and sail at 6. Dan, I'm not dotty yet. I've not sailed around the world five times for nothing. I know what the matter of breaking in a new crew means. I've had to deal with them, red, yellow and black, Lascars, Chinamen and Magyars.

Currie—Our crews are white.

Saunders—Yes, and often they are the worst. If you mean to tell me that you can break a crew in in one hour, I will inform you that, although I've seen some pretty hard knocks, I've not taken leave of my senses yet.

Currie—We don't break in any new men. We ship them from union headquarters, and they are all experienced steamboatmen.

Saunders—That's all well enough; but steamboats differ, and engineers differ too. You certainly have my sympathy, Dan, and I say, God be with you this night out on the lake with your one-hour-experienced crew. There will be no sleep for you for many watches to come. You will have to be everywhere at the same time. It will take days to knock your system into their thick heads. There will be cursing, and driving, and hitting galore. And there will be no peace for the man in charge for a long, long time. It's me as knows. I've drove across the Western Ocean with them where I've had to break half of their heads open in order to get anything into them. And here you are, Dan, sitting as calm as if you had no sailing orders in sight. Good God, man! Get busy. Slack up your connections, your new oiler is sure to forget to oil some of them; and then he'll put the thick heavy oil in the small cold pipes and the winterstrained in the big hot ones. Your firemen have probably been on a boat that carries heavy fires, and the first thing you know they'll have your furnaces crownsheeted. Then you'll have no steam, three or four hot connections, and there'll be something doing around the engineer. No, no, Dan! Take my advice and don't attempt it. Notify your manager, while there is yet time, that you can not leave until your crew is broken in. Ask him to give you forty-eight hours in order to get them knocked into some sort of shape.

Currie (leaning comfortably back in his chair, and reaching for a fresh Havana)—It doesn't worry me a bit.

Saunders—Sufferin' cyclones! Have you invented some new way of running steamboats?

Currie—It's not my invention. But, as you remarked a while ago, all these boats look alike. Now let me tell you that some time ago we reached the limit to the size of boats on these lakes. Since then only the maximum size has been built, and the others soon became obsolete. After we had standardized our boats, our next step was naturally to standardize the machinery. On all the twenty-five boats in this harbor, and the other five hundred on the lakes, the boilers, engines, auxiliaries and other contraptions are as like as peas out of the same pod. But that was not all; we went a step farther. After boats and machinery were standardized, we, who have to drive them season out and season in, standardized our working systems, and then we had it. This means that when my new crew comes aboard at 5 o'clock the onerous duty of breaking them in will consist of saying the weighty words: "Gentlemen, you will now get the ship ready for sea!" The oiler on watch will regulate the drips on the crankpins to every ten seconds, and twenty seconds on the crossheads. He knows that he will find his engine oil in the red tank, and his cylinder oil in the blue tank, because it is thus on all boats on the lakes. The firemen will light their pipes and sit down contentedly watching the stokehold telegraph, where a large pointer and capital letters tells them exactly what to do. While the assistant engineer only exercises his brains and his fingertips on a few small levers and electric buttons. If in the mean time a gauge glass should burst, the oiler will shut it off, and next proceed to the third drawer in the storeroom on the starboard side of the ship where he knows that he will find a new glass, because it is kept there on all boats on the lakes. Should I then take a sudden notion to disconnect the second joint on the auxiliary exhaust line, I would have to shout the gladsome tidings to the engineroom. Then one of the crew would proceed forward of the engineroom bulkhead because all second joints are located there. After arriving

there he would be among about twenty different pipelines; but he will disconnect the joint in the one painted red with black flanges. Had I said, auxiliary steampipe, he would have taken the black one with the red flanges. Five minutes after those men have stepped aboard they are as familiar with everything as they will be after a year's service, because they have never seen anything different. The moment we get under way they drop automatically into the right system of caring for the machinery, because there is only one system and that is the right one, and is the one they have been compelled to work under since the first day they steamboated. Thus, at 6:30 all handles on dopecups will stand crosswise of the ship, at 7 o'clock they will stand fore and aft. This eliminates the possibility of skipping a cup. I need not impress this on their minds and keep tab of them that it is enforced, because they have never seen it done otherwise.

Saunders—Good God! It must be heaven.

Currie—Well, as near to it as steamboating can come. And standardization is what has done it for us.

Curtain.

OLD CRANE.

With a jerk, a final bump, and a long sigh of exhaustion, the old crane came to a stop on track No. 1 of the shipyard.

"I have had enough of this kind of life," he said. "No more tons of steel will I lift. I don't care if 47 never gets launched—I have the grippe and here I stay till I'm rested."

The complaint of the old crane was most human; he had done his share of hard labor and now proposed resting.

A murmur ran through the shipyard—such a thing had never happened before. Work stopped on 47 and she anxiously waited for another load of steel.

"What is up with Old Crane?" asked Young Crane, as with great skill and dexterity he dumped several tons of steel plates into the frame of 46.

"I have never seen him stop before. How are they going to finish 47 without Old Crane to do the lifting? I'll stake one of my off hind wheels that Engineer Morehead is mad at him. He has been counting on having 47 launched three weeks from today, but with all work stopped there is not much chance of any champagne smashing on that date."

The noisy little riveting machines took up their b-r-r-r-r and the shipyard buzzed with work; but 47 stood silent. She had reached a stage where more steel channels were wanted and work could not go on until Old Crane felt inclined to do his share. Day after day went by and still he refused to move. No amount of fussing done by that subordinate creature man could budge him. It takes a woman's gentle pleading to touch an old sinner's heart.

"Aren't you ashamed of yourself?" shrieked the squeaky voice of one of the donkey engines, as he ran by with a load of castings. "Just look at yourself, Old Crane, sitting there in the dumps, while we have to do twice as much work to make up for lost time."

Old Crane did not deign to reply, but looked far out across the river, where the ice was going down in big chunks. Spring was in the air and even the ship-yard and Old Crane himself could not resist the joyous spirit of that sunny day.

"O come, Old Crane," he heard a voice say, as 47 took up her pleading.

"I want to get out of here and try my luck on the Lakes. I am crazy to see all these wonderful places which that old red hulk in the dry-dock has been telling me about. You were made here and will stay here all the days of your life, but I am being made for greater things—think of the grain I shall carry, and perhaps tons and tons of valuable ore. I shall be the finest freighter on the Lakes, Old Crane, if you will only come to and hand me up a little of my rib coverings. I am rather chilly, too; the wind blows right through me."

"Well, I suppose I shall have to, then, but after I finish you I'm going to drop to pieces." With a grunt of rage Old Crane started to work. Banging his hooked chains together, he grabbed up a great pile of trusses and channels and ran down the track to 47, who received him with open arms.

Again a surprised murmur ran through the ship-yard.

"Back to work again, I see," said the same saucy donkey engine.

"Yes, but not for you," snapped Old Crane.

47 smiled with pride at Old Crane working for her. Up came big loads of steel, the riveters were busy again, the launching ways were laid, and finally all was ready.

The day for launching had come, 47 was to take her first plunge into the chilly waters of the river, to drop her ship-yard number 47 forever, and to take a new name when the bottle broke over her bows. The last block had been knocked out. Old Crane and the rest of the ship-yard stood expectantly waiting for the last "cut." At a signal bow and stern lines gave way—47 shivered, started to slide, gaining speed as she went.

"Good-by ships," she called out. "Good-by, Old Crane; thank you for finishing me."

With a great splash and a huge wave she settled into the slip.

Old Crane did not fall to pieces; cranes never do. He is still doing his share of work with a grumble now and then; 47's victory over his blues has long been ship-yard history; but on her trips up and down the river she never fails to wave a hatch cover or wink a dead-light at Old Crane. G. R.

SEEN AND HEARD ON THE LOOKOUT.

Again, as happened in former springtimes, captains experience difficulties in hiring full complements of crews.

But the master of schooner Chas. K. Buckley hired two full crews more than he needed.

First the Buckley's captain engaged a crew and had them sign articles before the U. S. shipping commissioner.

"Boys," he said after this formality, "meet me tomorrow morning in Harris' clothing store."

Incidentally, Harris holds forth in a store at the foot of Broad street, in New York city.

Many captains have since visited this store but never he who commands the Buckley.

The latter signed another crew before a shipping master, and upon this gang of sailors hearing that they were crew number 2 they refused to go on board.

Then a third crew was speedily selected.

In the meantime, the first crew, the only crew that had a legal right to inhabit the Buckley's forecastle on this occasion, presented themselves before the U. S. shipping commissioner.

That official referred them to an attorney, and the attorney, O. F. Seggel, who is in charge of the seamen's branch of the Legal Aid Society, induced the captain to the take first crew. He (the captain) was not willing, however, to pay the men for the time they lost in waiting.

Then the men brought suit under U. S. R. S. 4527.

The case was tried before Judge Adams, and the following is the latter's decision:

"It seems to me that the master of this vessel discharged these men without any cause, and was only willing to take them when he was advised to do so by counsel, or advised by his better judgment that he was getting in trouble, which he undoubtedly was.

"He did not keep faith with the men, and while the men didn't suffer very much, and are probably using the statute, the only purpose of the statute, as I understand it, is to prevent any action of this kind to take care of seamen and to prevent people from taking advantage of them by failing to keep their agreements.

"Here they made an agreement to take these men on board at a certain time, the men were ready and they were not taken, and that seems to bring it directly within the statute, which reads:

DISCHARGING SEAMAN BEFORE VOYAGE.

"'U. S. R. S., 4527. Any seaman who has signed an agreement and is afterward discharged before the commencement of the voyage or before one month's wages are earned, without fault on his part justifying such discharge, and without his consent, shall be entitled to receive from the master or owner, in addition to any wages he may have earned, a sum equal in amount to one month's wages as compensation, and may, on adducing evidence satisfactory to the court hearing the case, of having been improperly discharged, recover such compensation as if it were wages duly earned.'

"The language is very felicitous to cover a case just like this. I do not see what the captain was thinking of when he refused to meet the men the next day, or provide for their being taken on board, especially as he wanted men. However, no motive was necessary to be shown under the statute I do not see that there is anything for the court to do but to enforce the statute. I have always hesitated about applying these penal statutes, taking something from one party and giving to another, without a commanding reason.

"There is, however, reason here; not reason enough, perhaps, to justify the allowance of $25 in cash in each case, though the court cannot do otherwise than allow the sum of what the statute directs.

"Therefore, there will be a decree for the libellants here for $25 each, and not anything beyond that."

Hurrah.

And now, what is the number of the statute (also felicitously worded, I hope) that covers a case where a crew has been signed but fails to show up at the appointed time?

It is a poor rule, etc.

After the accounts of the wreck of the steamship Berlin had been given to the reading public of all nations there came from several quarters adverse criticisms of the efficiency of the life-saving apparatus off the Hook of Holland.

Such criticisms, being heard at a time when the Dutchmen were acclaiming the heroism displayed by the life savers, induced a Dutch official, whose position is equivalent to that of our labor commissioner, to secure an answer to the following questions:

1st. What orders, if any, had been given the captain of the Berlin in regard to delaying his vessel at sea at a time when stress of weather made the entering of a harbor unsafe?

2nd. Under what circumstances did the accident happen, and what means for the saving of life were adopted?

3rd. Is the life-saving apparatus up-to-date; and, if not, what measures are being taken to bring it up to the standard of that set by other prominent ports?

And herewith are the answers elicited from life-saving experts:

1st. Captains of the Great Eastern Railway Co. mail steamers receive no special instructions as regards "heaving to" off the Hook of Holland in time of adverse weather conditions; the company trusting entirely in their captain's seamanship to take the necessary precautions.

2nd. The ship ran aground during a severe storm and while a heavy sea was running. But whether at the critical moment either the steering gear or the machinery became disabled shall probably never be known.

3rd. The only steam life boat extant along the coast of the continent of Europe hails from the Hook of Holland.

Said boat parted her cable during the attempt to rescue passengers from the Berlin, and it was while returning to port for another anchor that the doomed craft broke in two.

But for this accident to the life boat it is almost certain that the loss of life would have been far less appalling.

All devices for saving life were present but the exceptionally heavy sea made their use ineffective.

In conclusion, the commission of commerce and labor has decided that further investigation of the life-saving apparatus is uncalled for.

Nothing is easier than destructive criticism.

Though the weather during the first part of April was suggestive of winter, with its snowstorms and frost, the calendar declared that spring had arrived.

And yacht owners, disregarding the warnings of the weather bureau, testified their belief in the truth-loving qualities of the almanac by ordering their captains to "fit out."

Capt. Grant, he who commands the bark-rigged steam yacht Niagara, was one of the first to engage a crew.

In spring, namely, it is the earliest fitted out yacht that generally catches the best crew; and it was only when trying to secure a suitable boatswain that difficulties were encountered.

For—on a yacht like the Niagara a "suitable" boatswain is one who can convey the officers' commands to the crew by means of blasts on a whistle. Also—in this case—the boatswain was required to be a professional bugler. One man—a Swede—declared that he could "talk on a whistle like anything." But he failed to pass the bugler's examination.

Then a Russian applied for the soft berth, but, though proficient in blowing his own horn, he could not whistle, let alone blow the yacht's bugle.

Able seamen who are able to perform on the two above named musical instruments are apparently as difficult to secure as—well, to make it sufficiently strong—lighters in New York harbor at present.

Having inadvertently made the latter comparison let the offense be repeated, thus:

At present, referring to New York harbor, the superabundance of tugs is pro-ratio the scarcity of all kinds and conditions of lighters.

As a tug boat captain expressed it:

"We are quite able to move all the freight if only we had something to move it on, or in."

Thus endeth the first lesson of spring.

F. H.

BLOOD MONEY.

Recently the shipping masters sent an ultimatum to the agents of the steamship companies to the effect that a "$20 bonus" would be exacted for every man, sailor or fireman, securing a berth on an outward bound vessel.

But by this was not meant that the shipowners would be mulcted out of $20 for every seaman they engaged.

The term "$20 bonus" means: If x represents the amount of a seaman's "advance," or allotment, in dollars, and y the arbitrary exaction of the shipping masters, then the latter intend to see to it that x plus y equals $20.

Again, x is a certain amount of money for which the newly hired seaman promises to work a certain number of days; and y is money for which the shipping master promises to deliver the goods—the seaman, or some other seaman.

From the above it is plainly to be seen—even by those not acquainted with algebra—that the amount of money represented by "y" depends solely on the size of "x" (the amount the seaman gets in advance).

On American coasters (both sail and steam)—no allotment notes are issued; in fact, it is illegal.

And the owners of these coasters

are not affected by the exaction of a $20 bonus.

On the principle of "In order to curé a disease it is necessary to remove its cause," let shipowners agree to employ only those seamen who are willing to finish their task before requesting payment for same. The entire miserable business of "advance" has resulted in making seamen proverbially improvident, besides being the cause of the existence of the "shipping master" who now, like a veritable slave owner, dictates: "You cannot hire MY sailor unless you pay MY price."

By making it illegal to issue allotment notes; in short, by summarily stopping the practice of paying for a promise to work in the future, a great benefit will be done to both the shipowner and the seaman. F. H.

ELECTRIC TUGS AT NIAGARA FALLS.

One of the most serious problems of the several power developments located at Niagara Falls has been the handling of ice during the winter months. Not only is the normal formation of ice in the river serious, but under certain wind conditions in the great lakes large floes of ice are discharged from Lake Erie into the head of the Niagara river completely filling the river from shore to shore.

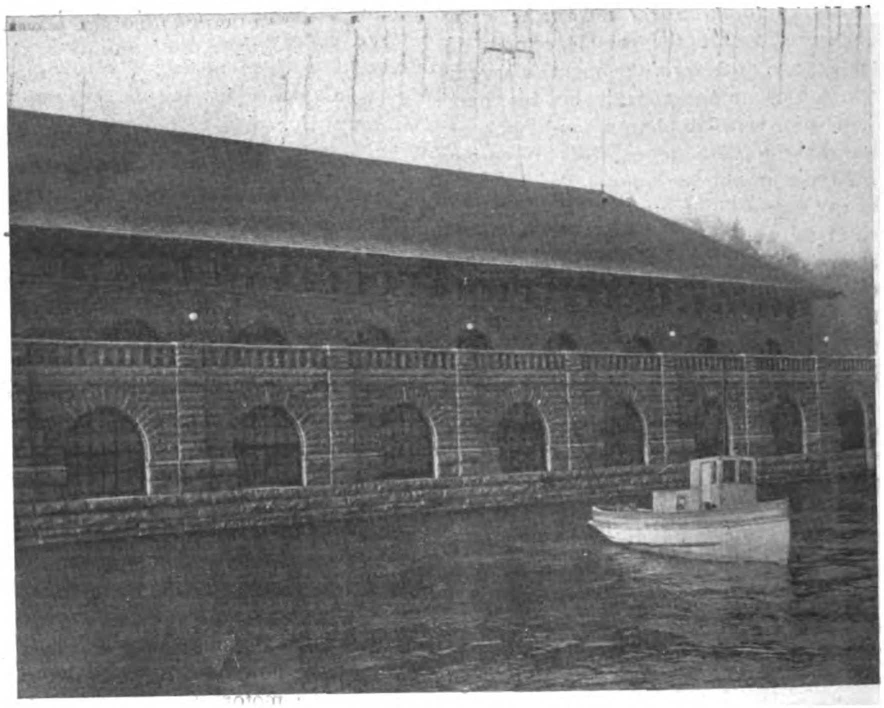
When the plant of the Niagara Falls Power Co. was first started, there was no similar installation of its kind in the world, and consequently there was no previous experience from which the engineers could draw for guidance in determining just what conditions could be expected in drawing water in considerable quantity from a comparatively shallow, but wide river, under severe ice conditions. The intake canal was set at an angle slightly less than 90 degrees with the up stream bank of the river. With this arrangement, it was thought that floating ice would be deflected by, instead of into, the canal entrance. As a further protection, log booms composed of a series of floating logs were placed across the mouth of the canal.

This proved partially effective, but as the output of the plant, and consequently the volume of water entering the canal, increased, large amounts of ice were drawn into its entrance. This ice, if allowed to pass into the penstocks, tends to clog the turbines, causing loss in efficiency and output, or even serious damage. To dispose of the ice entering the canal, a vertical shaft was sunk at its far end, emptying into the discharge tunnel from the wheel pit. As this shaft is necessarily located beyond the intakes to the penstocks, there is no draft of water towards it except that which is produced by the small amount of water which is allowed to pass through the sluiceway leading to the head of the shaft. Some additional means was therefore found necessary to propel the floating ice towards this sluiceway, as otherwise the ice accumulates, and builds up in the lower end of the canal.

It has been found that a tug boat is the most efficient and economical method of accomplishing this result. When moored with the propeller running at full speed, a large surface current of water is set in motion from the stern of the boat. By varying the length of the mooring cable, or by changing the point of mooring, this current of water can be directed from any point in the canal so as to effectively propel all floating ice towards the ice sluiceway. When not moored, the tug boat can be used to break up, and stir up any unusual accumulation of ice tending to block the intake canal.

For several years, steam tugs were employed for this purpose by the Niagara Falls Power Co., but as the work is only intermittent, it was felt that an electric tug would be more economical on account of lower operating expenses. With steam tugs, the government regulations require the steady employment of a pilot, engineer and fireman, and the nature of the work necessitated the keeping up of steam constantly, as the tug might be called for on a moment's notice. The area within which the tug had to operate was small so there was no physical limitations to prevent the use of an electric tug supplied with energy from the power house through an overhead trolley and cable.

Two years ago, the Niagara Falls Power Co. installed in its intake canal on the American side of the river a small experimental electric tug to supplement the work of a steam tug. This tug, which is still in service, is 25 ft. long by 8 ft. beam by 4 ft. draught, with a propeller 52 in. in diameter by 2 ft. pitch. It is supplied with power through an overhead trolley 750 ft. long composed of two No. 00 copper wires, 2 ft. apart, suspended about 35 ft. above the water, running lengthwise down the middle of the canal. The aluminum trolley carriage travels on these wires, and is of special construction designed by the power company's engineers.



ELECTRIC TUG OPERATED BY TROLLEY.

From the carriage a No. 00 duplex flexible rubber and braid cable leads direct to the motor controller through a hollow mast over the pilot house of the boat itself, the top of the mast being about 15 ft. from the surface of the water. The cable has sufficient slack to allow the tug to operate at either side of the canal giving an effective area of work the full width of the canal and the full length of the overhead trolley wires.

The electric equipment in the boat consists of one 75-H. P., single-phase, 220-volt, 25-cycle alternating current motor of the standard railway type with drum controller and grid resistances. The motor is geared to an extension of the propeller shaft through a single pinion and gear having a ratio of 16 to 66. This gives about 240 revolutions per minute to the propeller shaft with the

full load speed of 1,000 revolutions per minute in the motor armature.

The results obtained by this tug boat have been very satisfactory. It is available for service on a moment's notice, and is easily handled by one man who, when the boat is not running, can be employed on other work about the power house. There are no operating expenses, therefore, except when the boat is actually in service.

The success of this trial boat has led to the construction of a second and larger tug boat which was installed last fall in the forebay of the Canadian Niagara Power Co. This boat is of sufficient capacity to handle all the work at the Canadian plant, and is not supplemented by a steam tug. The boat operates along the outer wall of the power house, and its function is to prevent any large accumulation of floating ice, which if it were allowed to form, would finally be drawn through the submerged arches in the outer wall, and hence into the penstocks and the turbines.

By means of the surface current which it sets in motion, the boat propels all floating ice towards a spillway canal at the lower down stream corner of the outer wall of the power house, the spillway canal returning the ice to the river some distance below the entrance of the main intake canal. The Canadian tug boat is 40 ft. long by 10 ft. beam by 6 ft. draught, and its propeller is 4 ft. 4 in. in diameter by 2 ft. pitch. The trolley wires are two No. 00 copper wires, two feet apart, and run parallel with the outer wall of the power house for the full length of the forebay, a distance of about 600 ft. They are suspended from two steel trolley poles, 60 ft. high, located at the two opposite ends of the forebay. This height gives a wide range of operation with but little slack in the cable leading from the trolley carriage to the boat.

The trolley wires are secured through strain insulators, and the current at a voltage of 1,100 volts is conducted to them by a duplex No. 000 lead sheathed cable which is lead up one of the guy rods of the lower trolley pole. The trolley carriage is made of aluminum to reduce its weight, and is similar in design to that used in the American equipment. From the trolley carriage a duplex No. 1 flexible rubber and braid cable leads to the boat.

The electric equipment on the boat consists of one 125-K. W. air blast transformer and two 75-H. P., single-phase, alternating current railway motors of the same type as installed in the tug of the Niagara Falls Power Co. Several low voltage leads are brought from the secondary of the transformer giving a range of voltage from 56 to 220 volts with 1,100 volts impressed on the primary. This range of voltage is used in bringing the motors up to full speed or in running at reduced speed. A single controller of the drum type, in connection with the low voltage leads mentioned and with a preventative resistance and impedance coil for each motor, operates both motors. The two motors work in parallel, and are each geared direct to the 6-in. propeller shaft through a pinion and gear having a ratio of 16 to 66. This gives the same propeller speed as in the American boat, but the Canadian boat is much more powerful, developing a total of 150 H. P.

Power for operating the tug is supplied from the main switchboard at 11,000 volts, and is stepped-down to 1,100 volts through a 125-K. W. water-cooled transformer located in one of the sub-floor chambers of the power house. At this voltage the power is distributed to the trolley system as outlined above. Suitable meters, switches and circuit breakers are installed in the 1,100-volt circuit for the purpose of controlling and measuring the power used by the equipment.

In both the American and Canadian boats it is necessary to use air blast for cooling the motors and other electrical equipment, as the hull of the boat offers very little opportunity for the radiation necessary if self-cooled electrical apparatus were used. In the Canadian tug boat forced draft is supplied by a 1-H. P. alternating current series motor, direct connected to a blower. Air pipes with suitable dampers for properly regulating the flow of air lead from the blower to the motors and transformer cases.

The suction side of the blower is connected to the outside air. In this manner cold air is forced through the portion of the motors and transformers near the windings.

The hulls for both the American and Canadian boats were built on the ground by Benjamin L. Cowles, of Buffalo, N. Y., and are very solidly constructed of oak to prevent any possible damage by ice. Westinghouse apparatus was used for the entire electrical equipment of both installations. The general design of the equipment, installation of the machinery in the boats, and the overhead trolley construction were carried out by the power company's engineers.

Boston interests are reported to be about to contract for five large steel gasoline schooners for the West India and coastwise trade. The motors which would be placed in these vessels would give them a speed of six to nine knots an hour, exclusive of their sail power.

THE TRIALS OF THE GERMAN TURBINE CRUISER LUBECK.

The long series of trials to which the first turbine cruiser of the German navy, the Lubeck, has been submitted, both by the Admiralty and by her builders, the Stettiner Maschinenbau A. G. Vulcan, are very instructive in several respects. In the first instance, the Lubeck is a sister ship to the 10,000-H. P. cruiser Hamburg, which she closely resembles, except that the Hamburg is fitted with piston engines, and parallel tests were conducted with the two vessels. The Lubeck had originally been provided with eight small propellers on four shafts; and in addition to trials with these, other tests were made with two sets of propellers of larger dimensions. Further, some wheel blades of the cruising turbines having been broken, the clearance was increased during the repairs, without any detriment to the economic efficiency of the turbines. This is an important fact. We pointed out some time ago that theoretical considerations did not appear to justify the anxiety of turbine designers to work with as small a clearance as possible lest the efficiency be diminished.

The chief dimensions of the Lubeck are as follows: Length between perpendiculars, 103.8 meters (341 ft.); maximum width, 13.2 meters (nearly 43 ft.); draught, 5 meters (16 ft. 5 in.); displacement, 3,217 cubic meters (3,170 tons). She is equipped with ten watertube boilers, having a grate area of 33.9 square meters (365 sq. ft.), and a total heating surface of 2,746.4 square meters (29,780 sq. ft.) steam is generated at 15 atmospheres (213 lb. per sq. in.); there are no superheaters. The turbines of the Lubeck, built by the Deutsche Parsons Marine A. G. Turbinia, consist of two sets of main turbines, two sets of cruising turbines, and four astern turbines, arranged on both sides of a longitudinal bulkhead in the following order: Port side, outer shaft: high-pressure main turbine, astern turbine, condenser, propellers; inner shaft: low-pressure cruising turbine, low-pressure main turbine combined with astern turbine, propellers. Starboard side, inner shaft; high-pressure cruising turbine, low-pressure main turbine with astern turbine, propellers; outer shaft: high-pressure main turbine, astern turbine, condenser, propellers. Two of the astern turbines, it will be noticed, are built in the same casing as the low-pressure main turbines. Originally the two astern turbines on each side could only be put under steam simultaneously; they have now all separate steam pipes. The turbines are coupled in three ways: (1) For small speeds up to 14 knots, the steam flows through the high and low-pressure cruising turbines and the high

and low-pressure main turbines into the condensers. (2) For speed up to 18.5 knots, only the low-pressure cruising turbines in series with the main turbines in the same order. (3) For high speeds both the cruising turbines are cut out, steam entering directly into the high-pressure main turbines to pass into the low-pressure main turbines and condensers. When the speed is to be reduced the steam is throttled; to raise the speed, boiler steam is sent to the low-pressure cruising turbine (1), or to the high-pressure main turbines (2).

The runs were made—(*a*) with the eight small propellers; (*b*) four large propellers; (*c*) four small and four large propellers; and (*d*) lastly, with a set of four extra propellers; the dimensions being:

	Diameter.	Pitch.	Projected Area.
Small propellers	1.372 m. (54 in.)	1.372 m. (54 in.)	0.5922 sq. m. (6.37 sq. ft.)
Large propellers	1.70 m. (66.9 in.)	1.499 m. (58.8 in.)	0.8823 sq. m. (9.5 sq. ft.)
Extra set, outer shafts	1.60 m. (62.9 in.)	1.435 m. (56.4 in.)	1.203 sq. m. (12.9 sq. ft.)
Extra set, inner shafts	1.75 m. (68.8 in.)	1.575 m. (61.9 in.)	1.443 sq. m. (15.5 sq. ft.)

They are all three-blade propellers of manganese bronze. Fottinger torsion-indicators were fixed on each of the four shafts. As regards the relative positions of the propellers, the two outer aft propellers and the two inner forward propellers are in the same vertical plane. Particulars of the trials have been published by Geheime Marine-Baurat Veith in the *Marine Rundschau.*

According to the contract the Lubeck was, on the forced draft runs, to give the same speed as the Hamburg, and not to exceed her coal consumption of 0.9 kilogram per I. H. P. hour. In the six hours' runs the Hamburg did, at 10,000 H. P., 21.9 knots, and the Lubeck 22.25 knots at 662.5 revolutions. Steaming at 1,400 H. P. in the 24 hours' cruising runs, the Hamburg attained 12.4 knots, consuming 0.9 kilogram of coal, while the Lubeck consumed 1 kilogram per I. H. P., at 333.5 revolutions. In the accelerated 24-hour tests the Hamburg did, at 7,000 H. P., 20.2 knots, which would correspond to 568 revolutions of the Lubeck, which attained the same speed at 567.3 revolutions, but consumed 0.967 kilogram of coal, against 0.9. These trials, which took place in the shallow bay of Eckernforde, were repeated in December, 1905, in deeper water, when the comparative coal consumptions were: Hamburg, 0.803 kilogram; Lubeck, 0.868 kilogram. The eight small propellers were used in all these trials.

In the unofficial tests, the same eight small propellers gave the maximum speed of 22.37 knots at 672 revolutions, and 13,705 effective H. P., the slip being 25.11 per cent. The four large propellers, fixed on the aft bosses—to put them on the forward bosses would have necessitated too much alteration—gave the best speed of 22.93 knots at 623 revolutions and 13,029 effective H. P., with a slip of 25.97 per cent in shallow water. The figures for deep-water runs were 23.16 knots, 14,158.6 H. P., slip 26.5. In the third series of trials each shaft was provided with a smaller propeller forward and a large propeller aft, but the large propellers of the outer shafts had to be reduced in diameter by 4 in., as they were too close to the inner propellers. The resulting speed was the best attained during these trials—22.562 knots at 601 revolutions, 13,573 effective H. P., and slips of 15.51 per cent forward and of 22.67 per cent aft. The extra set of propellers was next tried, with the result: 22.551 knots, 625 revolutions, 13,879, effective H. P., slip 25.79 per cent.

Comparative unofficial trials were made with the Hamburg and the Lubeck in September, 1905, the Lubeck carrying her four large propellers. In the 20-knot trials the Hamburg indicated 7,027 H. P., and the Lubeck developed 7,662.4 H. P. at 508 revolutions; the coal consumption of the Hamburg was 0.97 kilogram per I. H. P. per hour (too high, owing to inexperienced stoking); that of the Lubeck, 0.95 kilogram; wind and sea were strong. In the 15.05 knot trials, the comparative figures were, Hamburg 3,308 H. P., 0.77 kilogram of coal, Lubeck, 3,297 H. P. at 390 revolutions, 1.02 kilograms of coal. With a high wind the coal consumption of the Lubeck went up to 1.14 kilograms, in a calm it went down to 0.91 kilogram; the coal consumption of the Hamburg was in both cases practically the same. In these runs the one or the other ship took the lead alternately for six hours, the other following in the wash.

The interesting comparative stopping trials are summed up in the following table. The first column marks the speed at which the ship was going ahead, when the four astern turbines were started; the five other columns mark the spaces traversed in meters before the ship came to rest. In order to avoid too large a diminution in the boiler pressure, owing to the steam consumption in the astern turbines, the drop of pressure in the boilers was limited to three atmospheres (42 lb.). It will be seen that the available sets of propellers were utilized in four ways. The figures indicate the distances traversed with all the four astern turbines under steam. In some other tests only two of the astern turbines were used; the Lubeck traveled about 23 seconds longer in that case, and an additional 100 meters further. The superiority of the Hamburg is very distinct, except at the slowest steaming. For the Lubeck the combination of the four small and four large propellers answered best.

Drawing conclusions we find that the maximum speeds of the two vessels were very fairly equal—a little over 23 knots in deep water. But the performances of the two engines when producing these maximum speeds differ considerably. In shallow water the Lubeck required 13,573 effective H. P., and the Hamburg indicated 11,848 H. P. when attaining the high speed; the figures for deep water were: Lubeck 14,158, Hamburg 11,582 H. P. The distribution and dimensions of the propellers are evidently important factors which will have further to be studied. In the coal consumption the Hamburg also comes out best, the averages being: for cruising speeds 0.868 kilogram, against 1 kilogram, and 0.803 kilogram, against 0.87 kilogram, per I. H. P. per hour for the fast 24-hour runs. Not reckoning the coal which the auxiliary machinery demanded, the Lubeck consumed during the forced-draft trials 11,396 kilograms of coal per hour at 22.265 knots, the Hamburg 10,066 kilograms at 22.2 knots. The Lubeck has been put into commission and has, on the average, wanted 8 per cent more coal than the Hamburg. Thus the radius of action of the turbine cruiser would be smaller than that of the piston-engine boat, and the stopping trials were not favorable to the turbine boat either. As regards weight of machinery, the boilers and engines, apart from auxiliary machines, of the Lubeck weigh 609 tons, those of the Hamburg 652.7 tons; the engines alone of the Lubeck weigh 271 tons, those of the Hamburg 323 tons. That saving in weight may, however, not be maintained in the future turbine engine. The space allowance for the

	Distance Traversed in Meters. Lubeck.				
Speed Ahead in Sea Miles on Reversing.	Eight Small Propellers.	Four Large Propellers.	Four Large and Four Small Propellers.	Four Extra Propellers.	Hamburg.
5	102	52	50	75	56
9	117	126	110	146.5	110
11	230	211	194	214.5	180
22	436	536	466	500	280

two engines is about the same; the turbine engines lie lower, and the armor deck has not to be arched over them, as with the piston engines. On the other hand, the cross bulkhead on the Lubeck had to be shifted two frames further aft.

The easy management and maneuvering of the turbine engines, the absence of vibration, and of unenclosed parts in motion, speak in favor of the turbine steamer. Throughout the trials the turbines worked well. Two accidents occurred, however, which necessitated the repairs already referred to of the wheel blades and caulking, occupying in each case a fortnight. But the boat could, during these periods, run with her uninjured main turbines. Yet, in spite of the easy management of the turbines, it has not, so far, been thought advisable to reduce the number of engineers. After all, however, the proper view to take is probably that, considering the short time of existence of the marine steam turbine the turbine comes out very well in her rivalry with the piston engine. The German navy is certainly not discouraged, and has ordered two more Parsons turbine cruisers. As regards the very interesting propeller problems, we should refer our readers to the instructive comparative experiments conducted at Washington.—*Engineering*, London.

NEW APPRENTICESHIP SYSTEM.

The following description of a new apprenticeship system is reprinted from a circular that Clayton & Shuttleworth, Ltd., are sending to anyone who is interested:

A new system of apprenticeship has been adopted in the engineering works of Messrs. Clayton & Shuttleworth, Ltd., Lincoln. It is believed that the system will not only interest many engineers, but also a large number of parents who would gladly put their sons into engineering works if they could feel assured that the boys would receive proper attention and be given the opportunity of thoroughly learning a trade. In arranging this system, the firm has had in mind the virtues of the old system of apprenticeship, under which master and man lived in close contact, and youths were educated mentally as well as manually in their trade. To graft the advantages of the bygone system on the so-called factory system of modern times is not an easy task, but it is believed that, unless manufacturers make the attempt, it will become more and more difficult to secure the skillful, intelligent workman now called for on every side.

With respect to the details of the new system, two chief aims have been kept in view:—(1) To supplement the shop work with courses of instruction directly bearing on the work in the shops; (2) to give to all deserving apprentices a varied shop experience.

Large engineering works have the opportunity, hardly possessed by technical or manual training schools, of giving practical class instruction on matters which, although of great importance in the daily routine of manufacturing which is carried on for profit, are too often neglected. By combining mental training with the shop work it is hoped to make more intelligent workmen, willing to use the brain as well as the hand.

Apprentices will be moved from one class of work to another at the discretion of the firm. Diligence, skill, and proficiency will be held to constitute a claim for transference to another class of work. Keeping a boy for months on routine work, simply because he has become skillful at it, will so far as possible be avoided.

Wages will be paid at rates comparing favorably with those paid for youths' work where little or nothing is learned.

The old term of seven years (from 14 to 21 years of age) is abandoned altogether. It is obviously too long a time to serve for any trade under modern conditions. Apprentices will be taken on at any age between 15 and 22. It is hoped that this will induce many boys who have the opportunity of attending school or college beyond the usual period to become apprentices. Courses of instruction will be arranged to suit boys whose parents cannot afford to keep their sons at school beyond 15 years of age; but it is hoped there will be a considerable number of apprentices entering the works at 16 to 18 years of age who have received a thoroughly good school education and will be able to derive advantage from more advanced courses. In order to encourage the entry of boys of 16 to 18, the same wages will be given them at starting as if they had begun work at 15.

No premium is asked, and no premium apprentices are taken.

All apprentices are under a superintendent, whose sole duties are to supervise, teach, promote, and advise. The firm maintains its own school in the works, and all apprentices can attend classes free; books and utensils are provided by the firm. Officials of the firm take part in the work of teaching the apprentices, and in general deal with subjects in which they are specialists. It is among the duties of the superintendent to prevent an apprentice from "drifting" through the works, to protect boys from favoritism or the opposite in the works, to report to the firm cases of merit or demerit.

The trades taught are as follows:—(1) General machining and turning, (2) fitting and erecting, (3) tool-making, (4) pattern-making, (5) joinery, wheelwrighting and wood-working; (6) molding, (7) smith's work, (8) boiler-making. An apprentice is placed in one or other of these trades when starting, and in general is not transferred to another trade during his apprenticeship. But so far as possible he is given opportunities of spending a certain portion of his apprenticeship at various classes of work allied to the trade to which he becomes attached.

Apprentices who show by their efforts and natural ability that they are likely to become fit for responsible positions will be given special opportunities in the higher branches of modern works management and administration.

In conclusion, it may be said that, while every industrious apprentice should be able, at the end of his time, to support himself as an ordinary workman, his advancement to positions of greater responsibility will inevitably depend on the success or otherwise of the efforts he makes during his apprenticeship to improve his general, as well as his technical, education.

We may add to this that the rates of pay range from $1.25 per week for a lad of 15 up to $4.50 per week at the end of the period of training. The amount varies with the trade learnt, boiler makers receiving the highest and general machinists the lowest pay. These rates of pay are, however, augmented by a scale of increases or awards based entirely upon merit. With regard to the statement that no premium is asked, we should explain that after a lad has passed his three months' probation and been accepted as an apprentice, he must either find $25—it may be paid by weekly installments—or obtain a sound surety for that amount. This sum is returned to him on the completion of his indenture, but it is forfeited if he is dismissed before the completion of his term.

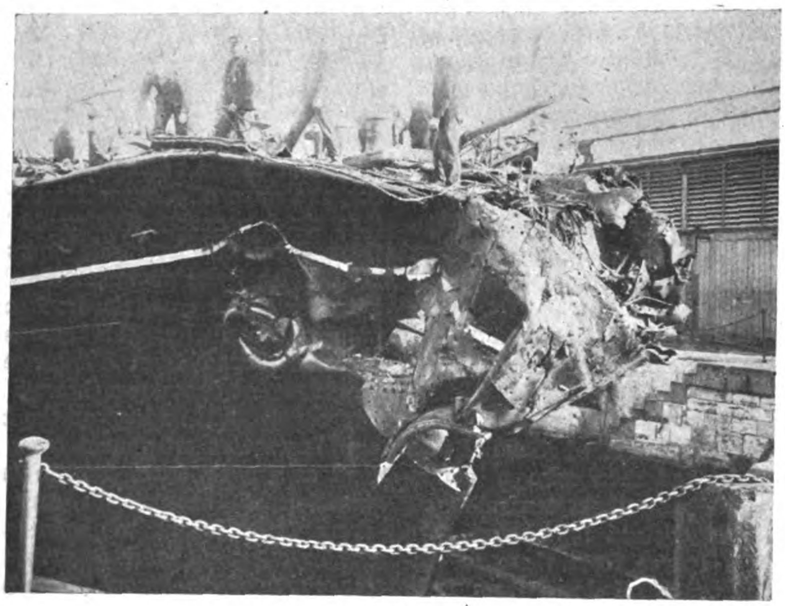
Capt. Thomas Johnson Jones, of the White Star liner Suevic, has been held responsible for the stranding of his vessel off the Lizard recently. In consideration of his previous good record his certificate was suspended for only three months. The causes assigned were that the speed of the vessel was underestimated, she being supposedly ten miles from the Lizard light when she struck, and that the light was not visible, owing to fog. The fog signals were not heard until shortly before the vessel struck the rocks, going full speed ahead.

THE INSTITUTION OF NAVAL ARCHITECTS OF BRITAIN.

The spring meeting of the Institution of Naval Architects in Britain opened on Wednesday, March 20, the presidential address being given by the Earl of Glasgow. Several very interesting papers have been read at this meeting of which the following are the most important from a shipping and marine engineering point of view:

The first was on the "Influence of Machinery on Gun Power of Warships," by Mr. James M'Kechnie, the engineering director of the Vickers Co. Having referred to the tendencies in design of warships, Mr. M'Kechnie pointed out that the exclusive adoption of 12-in. guns made it necessary to arrange that every gun should be able to fire on either broadside and at the same time to give the maximum of bow and stern fire. To the ordnance officer the space required for the propelling machinery created difficulty, because the position of engines and boilers could be modified only to a very limited extent. Moreover, the presence of boiler uptakes and funnels seriously interfered with the gun arrangement, and he proceeded to deal with work done at the Vickers Works at Barrow-in-Furness in connection with oil and gas engines for marine purposes, as these did not require uptakes and funnels. In addition to thus leaving the upper part of the hull free for guns, this machinery could be more conveniently disposed in the lower part of the ship so as to simplify the arrangement of magazines and ammunition supply. At the Vickers Works there had been constructed internal-combustion marine engines of a power equivalent to about 40,000-indicated horsepower, and for three or four years almost continuous research work had been undertaken. Continuing, Mr. M'Kechnie said: The experiment has led to the adoption of a two-stroke cycle gas engine possessing satisfactory features. This engine may be worked either by producer gas, heavy oil, or compressed air. It may be made reversible as easily as the steam or compressed air engine. It is possible to use in conjunction with it pressure-gas generators, which deliver their gas direct to the engines, as there is no necessity to pass it through a scrubber, or any other cleansing apparatus. There is thereby ensured the maximum of heat in the engine itself, since none of it is wasted in the process of cleansing. The cycle upon which the engine works renders it possible also to recover the heat of the exhaust gas and to utilize it in the engine. A gas pump is unnecessary, so that one of the chief objections to the two-stroke cycle engine is thereby eliminated. The compressed-air plant may be located in any part of the ship. From it one main leads direct to the propelling engines and another to the pressure gas producers. The steam required for keeping down the temperature in the producer and for preventing the formation of clinker is generated in association with the compressed air. The possibility of poisonous gases exuding from the mains has been carefully considered, and the supply pipes, as well as the producers, are jacketed with compressed air with which the gas escaping from the inner pipe passes to the producer or the engine. An important feature is that the engine may be worked either by gas or heavy oil, so that coal may be stored in the bunkers and oil in the double bottom. This gives a duplication which is always desirable. The change from gas to oil may be made almost instantaneously. Mr. M'Kechnie produced comparative designs of battleships of the same dimensions—the one with steam and the other with gas engines. The 16,000-H. P. machinery of the former weighed 1,585 tons, of the latter 1,105 tons. The gas-propelled ship had four screws. The steam-driven battleship was fitted with four 12-in., four 10-in., and twelve 6-in. guns, the most effective combination of ordnance in any warship up to 1905. In the gas-propelled ship it had been found possible, without increasing the length or displacement, to introduce five pairs of 12-in. guns, and to carry eighteen quick-firing guns of 4-in. caliber for repelling torpedo attack. The benefit derived from the abolition of boiler uptakes and funnels was still more marked. It enabled the turrets to be so disposed without increasing the length of the ship as to admit of all the ten guns being fired on either broadside. This more fully realized the demand for "all-round fire" for all guns than was the case in any existing ship. The internal-combustion engine installation allowed a much greater range in the gun distribution, and was more adaptable to a reasonable arrangement of magazines than was the case with steam machinery. Moreover, the temperature in the machinery room was lower, and fewer difficulties were involved in the satisfactory heat-isolation and ventilation of the adjacent magazines.

A similar comparison was also made between a steam and an oil-driven torpedo-boat destroyer. Mr. M'Kechnie preferred to indicate the effect made by the change on gun-fire rather than to utilize the economy in weight and space in reducing the size of the vessel or in increasing the speed. Instead of having only one 12-pounder and five 6-pounder guns, the oil-driven vessel was fitted with four quick-firing guns of 4-in. caliber and two 6-pounder quick-firing guns. Both vessels had two torpedo tubes. The quantity of ammunition—the number of rounds per gun—had not been reduced, although the guns carried were of greater caliber. A sufficient quantity of fuel had been allowed to give the oil-driven vessel, at the full speed of thirty knots, a radius of action 6½ times greater than that of the steam-driven destroyer with full coal supply. The absence of funnels and their fittings enabled the guns to have a much wider arc of training. There was usually much smoke and sometimes flames from the funnels of steam-driven destroyers, especially when running at full speed, and the absence of these in oil-driven craft would render them less liable to detection in war. Experience with six-cylinder oil engines at the Vickers Works showed that there will be less noise than with the reciprocating steam engine. Proceeding to deal with guns and gun-mounting machinery, Mr. M'Kechnie first briefly described the very finely-adjusted mechanism used in operating guns and their barbette mountings, pointing out that at five miles range a change in the target of 100 yards meant a difference in the position of the muzzle of the gun of only about six-tenths of an inch in the vertical line, or about forty minutes in the arc of training. The power of guns had added to the difficulties of the problem and to the stresses; the 12-in. gun, for instance, had in fifteen years increased in muzzle energy from 18,060 to 47,697 ft. tons. Mr. M'Kechnie, continuing, analyzed the advantages and disadvantages of hydraulic, electric, and other power systems for each operation in the turret, describing briefly but lucidly the mechanism for each action of the gun and the progress made in recent years, and in concluding made a general retrospective and prospective review. Propelling machinery forty-seven years ago, he said, gave 6.3-I. H. P. per ton weight, in the King Edward VII. 10.75-I. H. P., and today 12.5-I. H. P. The muzzle energy of two 12-in. guns had increased from 66,000 ft. tons in 1890 to 112,000 ft. tons in the present day gun, and yet the machinery had not greatly increased in weight, but had been simplified and improved to ensure more accurate control of the gun, a greater rate of hitting, and fuller reliability. The muzzle energy per ton of mounting had increased from 373 ft. tons in 1890 to 563 ft. tons now. Beyond all this, however, there was the still more important fact that while encouraging improvement in material, the distinguished officers responsible for our naval policy have brought about a great advance in the percentage of hits within a given time by perfecting the system of gun control, and had thus added enormously to the influ-



THE ORINOCO'S DAMAGED BOW.

ence of modern machinery upon the fighting efficiency of warships.

An interesting discussion followed, and full acknowledgment was made of the valuable character of the paper.

THE ORINOCO AND KAISER WILHELM DER GROSSE COLLISION.

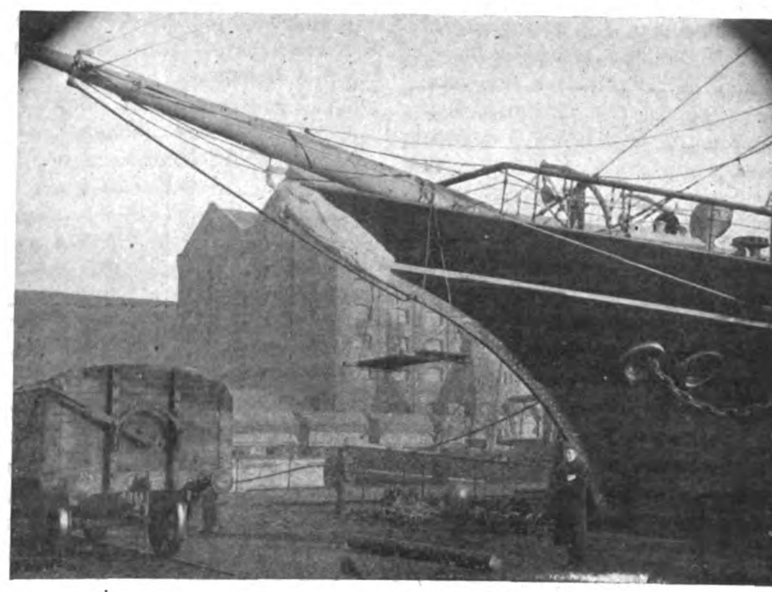
We have been favored by Messrs. J. I. Thornycroft & Co., of Southampton, England, with the three photographs of the Royal Mail Steam Packet Co.'s steamer Orinoco, showing the destruction to her bows after her collision on Nov. 21 last in Cherbourg harbor with the North German Lloyd steamer, Kaiser Wilhelm der Grosse. After the collision the latter vessel tore away the British liner's forecastle head and caused damage to the starboard 'tween deck plating and to the engine room of the German liner.

ANOTHER VIEW OF THE ORINOCO'S BOW.

The Royal Mail Co. gave the passengers on board the Orinoco the option of remaining at Cherbourg to await the following liner or of returning to Southampton by the Orinoco or another steamer. The damaged Orinoco on Nov. 23 proceeded under her own steam to Southampton where she was docked and repaired at Messrs. Thornycroft's works. Another of the illustrations shows the liner after renewal of the upper part of the stem, bowsprit, figurehead, hawsepipes, etc., and of several of the bow plates.

SHIP BUILDING ESTIMATES OF THE POWERS.

According to the British Admiralty, as published in the *London Times,* the amounts set down in the navy estimates, 1907-8, of Great Britain, the United States, Germany and France for ship building, repairs and armaments, are as



THE ORINOCO AFTER REPAIRS WERE COMPLETED.

follows (5 dollars to the pound):

Great Britain	$55,512,000
United States	46,935,360
Germany	36,435,125
France	28,620,840
Total	$167,503,325

The American outlay includes $4,109,-730 towards the accumulation of a reserve supply of ammunition.

WALTER J. BALLARD.

The United States steamboat inspectors Withey and Stewart, who conducted an investigation of the collision between the Larchmont and the schooner Harry Knowlton, have held the pilot of the Larchmont, who perished with his ship, responsible for the tragedy. Capt. McVey, of the Larchmont, is exonerated although he is not commended as a life-saver.

EAST AND WEST COURSES.

Editor MARINE REVIEW:—Referring to the article in the MARINE REVIEW of April 18 on East and West Courses, I consider the idea expressed therein of having boats take a course that will cause them to pass clear of one another a very excellent one, but think the courses should be reversed, that is, boats bound up should take the outside course instead of the inside course on Lake Huron and Lake Superior. The reasons for this are several. If the suggestion as put forth in the MARINE REVIEW were adopted the boats bound down Lake Huron when they reached Thunder Bay island light-house would be twelve miles off the light-house and would very frequently be unable to hear a fog whistle. Again when they get down to Sand Beach and are twelve miles off that point, they are again unable to hear any signals, and they would be pulling their boats in, and consequently the fleet bound up would be met between Sand Beach and the rivers. On Lake Superior according to the course recommended boats bound from Ashland would take a course that would bring them fourteen miles north of Copper Harbor, causing an intersection with boats bound up to Duluth and Two Harbors. This would be very dangerous, for boats bound down from Ashland would be continually crossing boats bound up. Boats leaving Detour by taking the outside course would be afraid of keeping away on account of dangerous shoals to the eastward of Detour passage and would want to steer out pretty well and would be sure to meet boats coming up to Lake Huron.

In regard to the steamer to leeward keeping away from the steamer to windward in thick and foggy weather, that should not be considered at all, because in foggy weather winds are very changeable, and one pilot might think that he is to leeward and another might think that he is to leeward, and it would also conflict with Pilot Rules Nos. 4 and 5. For instance if you were passing out of South East Shoal light ship bound down, and there was a steamer coming up from eastward and you had the wind southeast and the weather was foggy, the steamer bound down would be on the lee side, which would be going against rules 4 and 5 of the Pilot's Rules. The steamer bound down according to the suggestion of the MARINE REVIEW would have to keep out of the way of the steamer coming in, and that would be contrary to the Pilot Rules. Take the same situation at White Fish Point, where it is often foggy, if the wind was from the west, the steamer bound up would have to keep out of the way of the steamer bound down, and that would throw her to the left hand side and in close quarters, or in case of her wheel ropes parting, she would be on the wrong side if she wanted to reverse her engines.

Taking it all the way through if the course as mentioned in the MARINE REVIEW were reversed, and boats were to direct courses to the right or starboard side, the idea would be excellent. I would suggest that boats leaving Fort Gratiot, Lake Huron, would shape a course that would take them ten miles east of Sand Beach light-house, and then take a course that would bring them ten miles off Thunder Bay island light-house, then shaping a course from there to Detour. Boats bound down from Lake Superior coming out of Detour would run out on Frying Pan and Pipe Island ranges about ten miles, and then shape a course that would carry them three to four miles off Presque Isle light-house, and about the same distance off Thunder Bay Island light-house, and then shape a course from Thunder Bay Island light-house which would carry them about three or four miles off Sand Beach, and then from Sand Beach to the river. This would give both the upbound and downbound boats a chance to hear the whistles. If boats should happen to meet close, and the boats bound up were on the outside and those coming down were on the inside, in case of wheel ropes parting or in case of a misunderstanding, if they wanted to back their boats up and they would back to port there would be no danger of collision.

The only conflict on Lake Huron would be that boats bound to Lake Michigan would certainly have to cross boats coming down from the Sault on the right hand course, but this could not be done away with even if the course outlined in the MARINE REVIEW were adopted. By boats taking the right-hand course there would be no danger of collisions, because if boats met close they would be on the right side so that they could reverse their engines and back to port.

Boats bound down from Ashland on Lake Superior should take the outside course to bring them fourteen miles north of Copper Harbor, according to the MARINE REVIEW. Now I think this course is wrong and should be reversed. If the boats bound up Lake Superior should shape a course from Gross Cap reef gas buoy to carry them about two miles off White Fish Point light-house and then shape a course that would carry them ten miles off Copper Harbor, the same distance off Eagle Harbor and five miles off Devil Island. Then the boats bound down from Ashland or any that might be passing from the Apostle Islands, by taking the inside course to a point from four to five miles off Eagle Harbor, the same off Copper Harbor, and then shape a course that would bring them down on the inside course off White Fish Point about a mile off the light would not cross the track of upbound boats. By this course all steamers bound from Marquette and steamers that pass down through Portage Canal would be kept on the inside, and boats that are bound from Ashland or passing from Apostle Islands would leave them all to port side. From Devil Island to Duluth could not be improved more at present, because naturally one goes into a pocket there and boats would have to do as best they could.

Another feature in this right-hand course is that boats passing around White Fish Point, where they meet many boats, by taking the right-hand course a steamer wishing to back would be on the right side in case of collision if she wished to reverse her engines. If the courses are adopted in the rivers as well as on the lakes, the right-hand side should be taken, so that in case of wheel ropes parting or similar accident, they would always be on the right side.

THE MAN ON THE BRIDGE.

"AVAST!"

Of course the mate may have been jesting. But the young man who interviewed him and then gave out the story as Ship News says he said what is recorded here.

This is the mortifying finish to a half

STUFFING THE REPORTER.

column—devoted to an intensely exciting incident on the high seas—in a New York evening paper.

Can it be possible that the press is beginning to have grave doubts of the veracity of "those dear old sea-faring men?"

MARITIME NOTES.

Wireless telegraphy twice played an important part in summoning assistance to the disabled Clyde liner Arapahoe, which lost its propeller recently when sixty miles off shore. The first occasion was when a wireless message from the Arapahoe brought the Apache, also of the Clyde line and sister ship of the Arapahoe, alongside. The other occasion was when the cable, by which the Apache was towing the disabled vessel, parted, and a wireless to the Delaware breakwater, distant thirty miles, brought assistance from the shore.

The work of installing the new boilers on the fast American Liner St. Paul is progressing rapidly at the Newport News Shipbuilding yard, and it is expected that she will be again in commission about the beginning of June. The St. Paul is a great favorite with many of the regular trans-Atlantic voyagers, who deem her particularly seaworthy and comfortable.

THE AMERICAN LINER ST. PAUL AT NEWPORT NEWS.

"It is an ill wind that blows nobody good." When the White Star Liner Suevic went ashore on the English coast, two stowaways, who had been discovered beating a passage and were to be handed over for imprisonment on the arrival of the ship in port, took occasion of the general excitement to make good their escape. Several years ago a small coasting vessel was driven ashore and went to pieces close to a popular summer resort on the Firth of Clyde. The crew came to the shore in the ship's boats in the presence of a large concourse of spectators.

When the boats had landed the shipwrecked mariners, the spectators were surprised to see another form moving on the heaving deck of the steamer. At the muster of the crew every man had said "Here" to the roll-call, so they decided that the lone figure must be that of a stowaway. A boat, manned by volunteers, put out to the wreck and returned with the last survivor, who really was a stowaway.

Everything possible was done to make the men comfortable pro tem, but the stowaway's cap was passed around, to gather close on 100 dollars. Another instance of the "ill wind."

LAUNCHING THE W. B. DAVOCK.

The bulk freighter Wm. B. Davock was successfully launched at the St. Clair yard of the Great Lakes Engineering Works on Thursday last, and was christened by Miss Grace E. Davock, daughter of the man in whose honor the steamer is named. The steamer is building for the Vulcan Steamship Co. of Cleveland of which Mr. Davock is manager. The new steamer is one of the smaller type, being 440 ft. over all, 420 ft. keel, 52 ft. beam and 28 ft. deep, having triple-expansion engines with cylinders 21, 34½, and 57 in. diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 13 ft. in diameter and 12 ft. long. The Davock will be sailed by Capt. Benson Fox.

ITEMS OF GENERAL INTEREST.

Passenger navigation between Detroit and Buffalo was opened by the steamer Eastern States last week.

The steamer Robert L. Fryer ran on the rocks on the west bank of Ballard's reef through the parting of her wheel chains.

The steamer H. P. McIntosh left Bay City on her maiden trip last week, going light to Buffalo for a cargo of coal.

The steamer Charles Weston with a cargo of coal was the first vessel to arrive at Duluth from the lower lakes this season.

The steamer Henry B. Smith with wheat from Duluth was the first vessel to reach the port of Buffalo from Lake Superior this season.

The steamer Bessemer which broke her high-pressure cylinder off Colchester was towed to Cleveland by the steamer Wm. P. Palmer.

At a meeting of the directors of the Cleveland & Buffalo Transit Co., the regular quarterly dividend of 1¼ per cent, payable May 1, was declared.

The steamer Castalia was released from Fighting Island after lightering 1,000 tons of her ore cargo, which was later reloaded by the lighter Newman.

The steamer Andrew Carnegie broke the buckets off her wheel in the ice at the Sault and was towed to Duluth by the steamer Oliver.

The steamer John Stanton opened navigation in upper Portage lake after a hard struggle with the ice. The Stanton is delivering coal to Houghton.

The steamer Gordon was disabled through some disarrangement of her machinery on Lake Michigan off Twin River point and was towed to Manitowoc by the tug Arctic.

The steamer Vulcan of the Gilchrist fleet was taken to Buffalo for repairs to her hull, several plates having been damaged in collision with the bridge at Chicago last week.

Rendered unmanageable by the parting of her wheel chains, the steamer New York plunged into the Star line dock at Port Huron and damaged it seriously last week.

The master of the steamer City of Glasgow reports that his steamer struck an obstruction in Lake Erie off Colchester half a mile west and 900 ft. south of the stake placed to mark the sunken steamer Armenia.

The steamer Alexander Nimick in trying to break a channel through the ice from Portage lake to Huron, stove a hole in her bow. Water came in so rapidly that the steamer had to back out of the ice and run on the shore.

Thompson & LaVaque, owners of the steamer N. C. Neff, of Duluth, have been awarded contract to carry supplies to the construction crew for the new light-house on Rock of Ages which the United States government will erect this year.

The tug Buffalo, belonging to the Great Lakes Towing Co.'s fleet, bound from Duluth to Marquette, went down in 48 ft. of water in Portage lake this week. She was cut through by the ice but the crew succeeded in escaping. She will be raised.

Work on getting the steamers Hurlbut W. Smith and Wm. Nottingham off the beach at Buffalo is progressing slowly. Repairs are being made while the steamers are on the beach, so that they will be ready to receive cargo when they are once afloat.

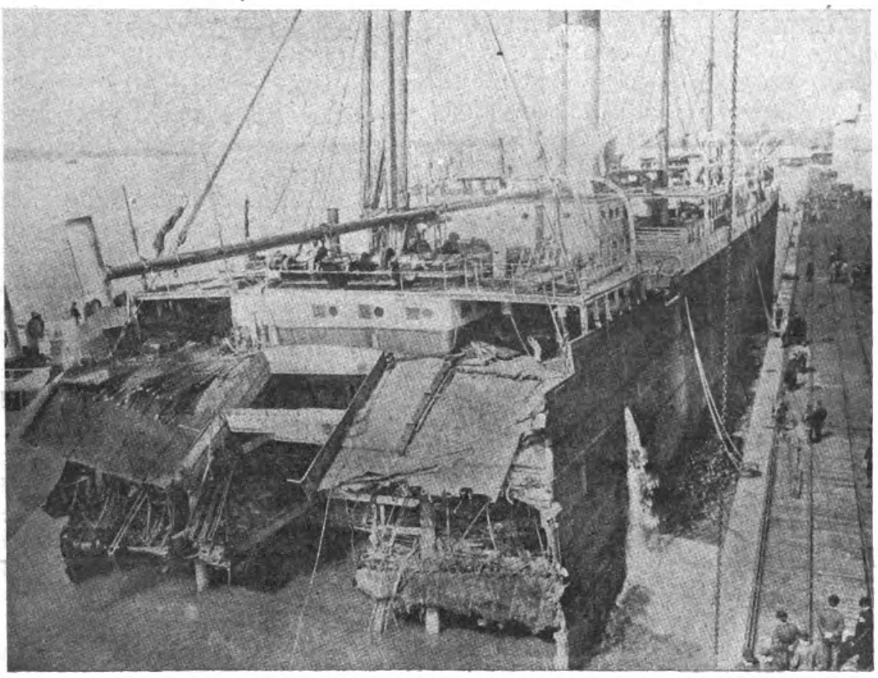
The Cleveland Punch & Shear Works, Cleveland, recently shipped to the Newport News Ship Building & Dry Dock Co., Newport News, Va., one of their punching and shearing machines, 30-in. stroke and weighing 62,000 lbs. It is belt-driven, has punching attachment up to 1¾-in. plate.

THE SALVAGE OF THE SUEVIC.

What Capt. McClellan, of the Liverpool Salvage Co., who had charge of the operations, has justly described as "the biggest job ever performed" has been crowned with complete success. The *Shipping World* says that the recent stranding of large vessels has been used as an argument against their size; but obviously salvage equipment has kept pace with the increasing dimensions of our present-day vessels, and there is no ship too large for the modern wreck-raiser if there is the faintest chance of saving her. Some days ago the huge American Pacific liner Dakota was described as a total loss; but, nevertheless, Capt. F. Young, of the Liverpool Salvage Co., is now hurrying on his way to Japan to investigate matters for himself; and we read that the success that has attended the operations of the Suevic has decided the salvage engineers in attendance also to try the process of dynamiting the Dakota. Thus once more English initiative points the way to a possible triumph.

It is not, of course, the first time a vessel has been cut in two on the rocks and half saved from total loss. Although the case of the Suevic is unquestionably the most important, as it is the largest and most daring, pride of place must be given to the Milwaukee, which ran ashore on the Scaurs of Cruden, off the Aberdeen coast, some years ago, and was cut in two, and remade by the famous Wallsend firm on the Tyne. And it is only the other week that the Nelson liner, Highland Fling, 4,088 tons, which went ashore on the Cornish coast last January, was severed by explosives and successfully floated; and there may be other cases. As one of those curious instances of "the long arm of coincidence," it is stated that while the salvage operations on the Suevic were at a critical stage, the reconstructed Milwaukee appeared above the horizon. It was regarded as a good omen.

The story of this brilliant piece of salvage work may be briefly told. The cutting of the vessel in two was performed under great difficulties. Owing to the Suevic being loaded the divers had to operate from outside. There was a strong spring tide race under the ship's bottom; and the men working at a depth of 40 ft. were actually standing on two other wrecks. As holes were blasted in the side of the vessel carcasses of mutton were set awash, and the divers had to evade these as best they could. About four o'clock on Tuesday morning of last week, after a fortnight of almost continuous labor, the huge vessel was severed in two. On the previous evening practically only the main steel deck remained to be separated, and the after part of the vessel was rising and falling buoyantly in the long Atlantic swell. Another account says that she parted below water at six o'clock in the morning; but, at all events, about 8:30 the salvage steamer Ranger and the Liverpool tugs Blazer and Herculaneum had her in hand and pulled her clear of the rocks. About 180 ft. of the fore part was left behind, while 370 ft. of her total length of 550 ft., or practically two-thirds of the vessel, has been saved. Not only that, of course, but the portion saved contains the valuable machinery and the costly fittings of her staterooms.



SHOWING HOW THE SUEVIC WAS CUT IN TWO BY DYNAMITE.

The vessel was got under way stern first, and assisted by her own steam and in charge of three tugs, she proceeded slowly up the channel. She floated almost upright and on an even keel, and made no water aft. Southampton was reached without mishap at noon on Thursday, and the prize was moored alongside the River Test quay. Naturally a large crowd has since been attracted to the harbor, where the vessel presents a very remarkable sight. She has been cut near the refrigerating chambers, and the section opened to view displays a mass of broken pipes and woodwork.

BRITISH NAVAL CONSTRUCTION.

The following is a brief statement of the work of the British admiralty during the year ended March 31, 1907, and of the work now in hand:

Between April 1, 1906, and March 31, 1907, the following ships have been completed and become available for service:

4 battleships (Africa, Britannia, Hibernia, Dreadnought).

3 armored cruisers (Achilles, Cochrane, Natal).

7 first-class torpedo boats.

11 submarines.

Floating dock for submarines.

The sum of £7,340,618 will be spent on the continuation of ships already begun; £759,382 in beginning new ships; of this £107,100 will be devoted to the fast unarmored cruiser to be laid down at Pembroke, £307,482 on torpedo vessels and submarines, £344,800 on new large armored vessels.

On April 1, 1907, there were under construction:

5 battleships.

7 armored cruisers.

8 ocean-going torpedo boat destroyers.

17 first-class torpedo boats.

12 submarines.

1 royal yacht (Alexandra, expected to be ready in September next).

The strike on the Clyde will probably cause some delay in the completion of ships building in yards in that district.

The Moran Co., Seattle, Wash., has contract for a single-decked steel cargo vessel of 1,370 tons for Schubach & Hamilton, Seattle, the vessel to be a duplicate of those now building at the same yard for the Dollar Steamship Co., San Francisco. The Moran Co. will also build a steel steam schooner 140 by 27 by 13 ft., to cost $115,000, for Black & Short.

SCREW PROPELLERS.*

BY T. SIDNEY COCKRILL, M. I. MECH. E.

The object of this paper is to consider the general features of screw propulsion and propeller design, with which, no doubt, many members of this society are already well acquainted, and to bring to notice a few points bearing on the subject which have occurred to me from time to time. There is no subject connected with marine engineering on which a greater diversity of opinion exists. Eminent members of the profession have, at times, laid down the most conflicting pronouncements with respect to screw propulsion. So it is hoped that this paper will lead to an interesting discussion, from which the author hopes to gather much useful information. The existence of such difference of opinion on the subject is probably due to the fact that little is really positively known of the mechanics of screw propulsion, or the forces set up by the action of the screw. There are so many disturbing factors, such as progression of the wake, and variation of its speed at different points, augmentation of the ship's resistance caused by the propeller itself, skin friction of the blades, effects due to rotation of the race, effects due to position of the propeller, eddies, cavitation, and numerous other influences whose effects cannot be calculated, that it seems almost hopeless to attempt to use first principles in solving the problems involved.

The want of exact scientific knowledge is to be deplored, for when one contemplates the very extensive use of the screw propeller, and how largely the speed and economy of the ship depend on its design and proportions, it is seen that the saving which would follow on more perfect knowledge must be very great.

To meet this want, the governments of this and other countries, and one or two shipbuilding companies, have constructed experimental tanks in which the performances of model propellers and ships of varying forms can be ascertained; and the results arrived at have been found so closely to agree with the actual performances of the full size propellers and ships, the dimensions and forms of which have been determined by the model experiments, that there is no doubt but that in the future tank experiments will become the practice for determining the most suitable dimensions of propellers. At the present time, when the turbine, with its increased speed of rotation, is replacing to such an extent the reciprocating engine for vessels of over 15 or 16 knots, modifications in propeller design render previous practice almost worthless as a basis for designing new propellers, and the experimental tank is practically the only means of securing the highest possible efficiency.

*Read before the Liverpool Engineering Society.

The greater part of our knowledge of screw propellers is due to the two Froudes, father and son, who carried out a series of experiments in the admiralty tanks, extending over some 30 to 40 years.

The principle on which the screw (as well as all other marine propellers) acts, is that the reaction caused by the projection of a stream of water by the propeller in one direction produces motion of the vessel in the opposite direction. And since rate of change of momentum is proportional to the force which causes it, the force exerted by the propeller is proportional to the momentum per second of the stream of water which it projects. Action and reaction are equal and opposite, and therefore the force exerted by the propeller in driving the water astern is equal to the thrust in the ahead direction; and this again is equal to the resistance of the ship. Using standard units of measurement, this means, in short, that the momentum of the stream projected astern by the screw is the measure of the resistance of the ship.

The momentum of the stream, or "race," as it is called, is the product of the mass of the water projected in one second and its velocity relatively to the surrounding water, or $M = m(v - V)$. The meaning of the symbols will be found at the end of this paper. And the mass of the race projected in one second in turn depends on the area of its cross section and its velocity relatively to the ship $m = \frac{W}{g} A\,v$. The momentum of the race is, therefore, equal to $\frac{W}{g} A\,v\ (v - V)$ and this is the measure of the thrust of the screw, and also of the resistance of the ship.

The energy expended in setting in motion the water forming the race is lost so far as propelling the vessel is concerned. This energy is $= \frac{W}{2g} A\,v(v - V)^2$. That is to say, it varies directly as the mass of the water acted upon, but also as the square of its final velocity. If the mass of the water acted upon were doubled, the loss of energy would be doubled; but if the final velocity were doubled, the loss of energy would be increased fourfold. The most efficient propeller is, therefore, that which projects the greatest mass of water astern at the lowest speed.

Theoretically, the lower the sternward speed of the race relatively to the ship v, for a given value of V, the greater is the efficiency; and it follows that the larger A is made, the more efficient would be the performance.

As the sectional area of the stream of water A which is projected astern by the screw type of propeller is, owing to practical circumstances, larger than that projected by any other type, the velocity of the stream v may be less with the screw than with other types; and this is really the fundamental reason why the screw is the most efficient form of propeller. There is, of course, practically only one other type of marine propeller now used—the paddle wheel; but, in spite of certain disadvantages, the screw has proved to be the better type, taking everything into consideration, and is used very much the more extensively.

The formula for the exact value of the thrust of a given screw propeller, even when it is working under the most favorable conditions, has yet to be invented. The leading principles involved in screw propulsion may, however, be defined.

The resistance of the ship, after its inertia has been overcome, is due to the resistance of the water and the resistance of the air. The resistance of the water may be sub-divided into frictional, wave-making, stream-line, and eddy-making resistances.

The resistance in a sea-way is further augmented by the wind and waves, and the pitching of the ship. The resistance in smooth water can be estimated with a very small degree of error, but that in a sea-way is beyond the range of mathematics. It may, however, be remarked that length, size and weight in a ship seem to counteract the adverse effects of wind and waves in a sea-way; and we in Liverpool can bear witness to this, having become quite accustomed to the regularity with which our large ocean liners arrive in port under all conditions of weather.

Referring to the disturbing influences acting between the thrust of the screw and the resistance of the ship, it is proposed at this point to consider two of the most important, one of which, it will be seen, is due to the effect of the presence of the ship on the propeller, and the other to the effect of the propeller on the ship. The first is the wake, or the forward motion imparted to the water through which the vessel moves; and the second is the augmentation of the ship's resistance caused by the sucking action of the propeller.

When a vessel moves through the water it tends to drag with it the water immediately surrounding it. This is caused chiefly by the friction between the skin of the ship and the particles of water in contact with it, but also by the stream-line motion and the waves set up by the motion of the vessel. The water which thus tends to accompany the ship is tech-

nically known as the wake. The speed of the wake is greater in the immediate vicinity of the sides and bottom of the ship, and becomes gradually less the further it is removed. It is also greater at the after part of the vessel, on account of the motion being gradually impressed on the water as the vessel moves through it; and for the same reason the speed of the wake is greater in the case of long vessels.

The water in which the propeller works is, therefore, not at rest, and the speed of the propeller through the water is not the same as the speed of the ship. If we denote the speed of the ship by V, the speed of the wake by w, and let V_1 equal the speed of the propeller through the water in which it works, then $V_1 = V - w$. That is to say, the propeller advances through the water at a speed *less* than that of the ship by an amount equal to the speed of the wake. The effect of this is that the thrust of the propeller is *greater* than it would be were it working in still water. The increase in thrust due to the wake means that a portion of that part of the energy developed by the engines which is expended in giving motion to the wake, is returned as useful work in the form of an augmentation to the natural thrust of the propeller.

In twin-screw vessels, owing to the propellers being further removed from the hull, the increase in thrust derived from the wake is less than that in the case of single-screw ships.

The second disturbing influence is the effect the propeller has on the ship behind which it works. When a propeller is revolving and throwing a stream of water in a sternward direction, it has the effect of reducing the pressure of the water in front of it. Owing to this, the pressure of water on the after part of the ship is less than it would be if the propeller were at rest. There is therefore a reduction in the water pressure behind the ship, and the effect of this on her performance is precisely equivalent to an increase of pressure in front, viz., an augmentation of the resistance against which the ship moves. The propeller has therefore not only to develop an amount of thrust to overcome the natural resistance of the ship, or, in other words, to exert a force equal in amount to that which would be required to *tow* the vessel at the same speed, but it has to exert an additional amount of thrust to overcome that augmentation in the ship's resistance which is due to the action of the propeller itself.

Here again, as in the case of the effect of the wake, there is a difference between twin-screw vessels and single-screw vessels. Twin-screws, being further removed from the hull, do not cause so much loss in pressure on the after part of the ship as single screws, and, therefore, the augmentation of resistance is less.

Coarse pitch propellers produce a greater augmentation of resistance than fine pitch propellers; this, perhaps, accounts for the higher efficiency of fine pitch propellers.

Considering the net result of the gain in thrust resulting from the wake conjointly with the loss due to the propeller augmenting the ship's resistance, it was found by the Froudes that for most types of vessels the gain due to the wake and the loss due to the augmentation of resistance so nearly balance one another that they may be neglected in most calculations affecting propeller design. The cancellation of these two factors (each of which taken by itself would be sufficient to upset any prediction as to performance) is due to the fact that for most types of ships, the conditions which are favorable to causing an increase in gain of thrust from the wake, are also those which tend to an increase in the augmentation of resistance; and *vice versa*. It must not be forgotten, however, that in the case of vessels of unusual proportions of speed, or other conditions affecting the design of the propeller, it is unsafe to take it for granted that these influences are in equilibrium.

NUMBER OF SCREWS.

In order to obtain the required thrust to overcome the total resistance, it is necessary to have a certain propeller disc-area if the slip of the propeller is to be kept within reasonable limits. The disc-area of a propeller is the area of a circle of the same diameter as the diameter of the propeller over the blade tips. To obtain this disc-area it may be necessary to have only one propeller; or two, or even three or four propellers may be required. It is the disc-area on which the area of section of the stream thrown sternwards depends, the stream being, in fact, an annular column equal in area to the disc-area less the area of the boss. In the case of cargo steamers of moderate speed and ordinary draught of water, the thrust required is easily obtained from one screw. The draught of water in these vessels not being restricted, a propeller of large diameter may be used, giving the required area of section of stream without resorting to duplication of screws.

With higher speeds the resistance increases quickly, being as the square of the speed for moderate speeds; but the resistance often varies at a very much higher power of the speed at higher rates of speed; so that in the case of passenger vessels it is necessary, as a rule, to employ twin-screws to obtain the necessary thrust.

When the draught of water is limited again, twin-screws may be necessary, on account of the draught being insufficient to allow of a single screw of sufficient disc-area and adequate immersion.

In the case of very large powers it is deemed inadvisable to transmit the whole power through one line of shafting, the diameter of shaft required being too large to ensure sound forging. And again, twin screws with two sets of engines obviate to some extent the risk of total disablement at sea.

In the British navy twin screws are the rule, chiefly on account of there being less chance of total disablement in action, but also on account of greater maneuvering ability (which is, of course, a very important consideration in warships), and on account of reduction in the height of the engines, whereby the cylinder tops are well below the armored or protected deck, so minimizing the risk of injury from shot and shell. In the American and German navies many of the battleships have triple screws driven by three sets of engines, the center engine and propeller alone being used when steaming at cruising speeds.

The practice of fitting two or three propellers on one shaft for high-speed vessels has, it seems, been abandoned, probably on account of the interference which must inevitably take place. It is noteworthy that in the case of some high speed vessels (the Turbinia, for instance), which had originally two or three propellers on each shaft, a single propeller of larger diameter has been fitted to each shaft, and better results have been obtained.

NUMBER OF BLADES.

There is not much doubt but that a propeller with two blades is more efficient under favorable conditions than propellers with three or four blades, but its efficiency is greatly impaired in a seaway. The higher efficiency of the two-bladed propeller is due to absence of interference between the blades, and to there being less edgeway resistance. Experience has taught us, however, that on the whole, in actual practice three blades are best for propellers which can be well immersed below the surface of the water, such as the relatively smaller screws of vessels with two or more screws; and that four blades are best for the large propellers necessary for single-screw ships, these being comparatively near the surface of the water.

SHAPE OF BLADE.

In designing the shape of the blade, it should be borne in mind that whereas blades having their greatest breadth comparatively near the tip develop more thrust, yet this advantage is practically nullified by the greater frictional resistance of blades of this shape, owing to the broadest part of the blade being situated near the part of greatest circumferential velocity.

The number of patents taken out for

shapes of propeller blades alone is legion, but experience seems to prove that the elliptical shape is preferable for most ordinary cases. The admiralty have long adopted this shape for all classes of warships, and there seems to be no reason in the majority of cases for departing from it.

Speaking generally, the shape of the blade has little influence on propulsive efficiency, but vibration may be reduced by having a suitable shape. The chief considerations as regards efficiency are the relations between diameter, pitch and surface. It is more than probable that the shape of the section of the blade is of greater importance than the shape of the blade itself. The blade should be as thin as possible consistent with strength, so as to reduce its edgeway resistance as it revolves in the water. This rule applies with increasing force from the root towards the tip, the circumferential velocity being higher as the tip is approached, and the resistance increasing proportionately as the square and still higher powers of the velocity.

The edges of the blade should be fine and sharp, and the shape of section of the blade should the natural stream-lines for the speed intended, so as to prevent eddies and reduce edgeway resistance to a minimum.

The blades of high-speed vessels are usually made of bronze, owing to the strength of this material allowing of very thin blades, and to its being non-corrosive; the blades have knife-edges, and are polished on both sides.

The use of bronze for propeller blades for all services should, the author thinks, have more consideration than it appears to have at present. Bronze blades may be made much thinner than cast-iron blades, they have smoother surfaces, the edges preserve their keenness, and they do not deteriorate by corrosion and pitting, so that the resistance of the propeller itself is very much reduced; and, after all, there is the intrinsic value of the bronze as scrap to be taken into account when considering the increased first cost.

DIAMETER OF PROPELLER.

The diameter of the propeller is fixed by the required disc-area, about which something has already been said when considering the number of screws. Theoretically, the efficiency rises with increase in the weight of water acted on, so that the larger the diameter the higher will be the efficiency. The diameter should never be so large, however, as to cause the tips of the blades to break through the surface of the water, or even to be near the surface under ordinary trim, as then the blade carries air down with it, and the presence of air in the race is the cause of a great loss in efficiency. The mixture of water and air is not only of lower density, but the presence of air lowers the speed at which water will flow to the propeller, and the result is racing or acceleration of the speed of rotation. Racing in a sea-way is, the author believes, as much due to the presence of air in the race as to the blades being partly out of the water.

A circumstance which tends to upset the theoretical rule that the larger the propeller the higher will be the efficiency, is that the resistance of the blades increases more and more rapidly with each unit of increase in diameter. A large diameter propeller, while being efficient owing to the large amount of water acted upon, may absorb so much power by its own resistance that it would not give such good results as a propeller of smaller diameter. The point is, in fixing the diameter, to ascertain at what point in the scale of diameters the rapidly rising curve of resistance overtakes the less rapidly rising curve of theoretical efficiency. The efficiency of reciprocating engines, however, usually rises with decreased revolutions, so that even the "ultimate" efficiency of the propeller may be sacrificed to some extent in order to gain in the total efficiency of the engine and propeller combined.

Too small a diameter results in an abnormal amount of slip and consequent waste of power.

Vessels with bluff lines require larger diameter propellers than vessels with fine lines, the water in which the propeller works being more disturbed. With a propeller of large diameter the blades reach out into more solid water.

Referring to propellers driven by turbine engines, the thrust developed is proportional to the square of the diameter D^2, and also to the square of the velocity of the stream driven sternward, presumably $= (P \times R)^2$. These terms are reciprocals of one another to obtain the same thrust. But if the diameter be made too small, and the $P \times R$ too great, a loss in efficiency will result owing to an abnormal slip. In the engines the velocity of the turbine blades is fixed almost beyond consideration, being about 0.5 that of the steam flowing through the turbine. The mean velocity of the blades $V = D_B \pi R$; where $D_B =$ the diameter of the rotor taken half way along the blades. It will be seen that an increase in revolutions R means a decrease in the diameter of the rotor D_B, and consequent saving in the weight and space occupied by the turbine. It is therefore very desirable to run the turbine at as high a speed of rotation as possible, but as this also means reduced diameter of propeller and consequent loss in propeller efficiency, a compromise must be made so that the combined engine and propeller efficiency may be as high as possible. It appears probable that a higher combined efficiency would result if slightly larger turbines than those in use at present, with corresponding decrease in revolutions and increase in propeller diameter, were adopted.

The point to be inculcated with regard to propeller efficiency is the absolute necessity of a free and unrestricted flow of water to the propeller; and this can only be obtained by moulding the run of the vessel as fine as possible, and of such lines as not to interfere with the natural stream-like motion of the water as it closes in under the stern.

It may be remarked here that all obstructions to the free flow of water round the propeller boss should be avoided, especially for high speeds. The nuts for securing loose blades should be in recesses, with plates fitted over, to preserve the contour of the boss. A conical cap should always be fitted at the after end of the boss. The length and shape of this cap should be designed to suit the stream-lines abaft the boss for the intended speed, for if the cap does not *entirely* fill the cavity formed by the water behind the boss, it will not serve its purpose, and may just as well not be fitted. Means should also be provided for preventing eddies at the after ends of the stern-tubes and other places; and for preventing the too sudden parting of the water at the fore end of the propeller boss.

BLADE-AREA.

The area of the blades, or blade-surface, is conveniently expressed as a fraction of the disc-area.

The following table gives the ratio of blade-area to disc-area which is generally adopted:

Cargo vessels with full run, single-screw	.31 to .34
Cargo vessels with medium run, single-screw	.34 to .37
Cargo vessels with fine run, single-screw	.37 to .39
Launches, single-screw	.34 to .36
Fast passenger vessels, twin-screws	.40 to .43

It is generally thought inadvisable to go beyond .5 or .6 on account of causing interference between the blades; but in some high-speed turbine-vessels the ratio is considerably higher than this.

PITCH.

The pitch is sometimes made to increase gradually from the root to the tip of the blade; and in some propellers the pitch is uniform over the blade except near the boss, where it is finer. The object of a decreased pitch near the boss is to minimize the churning of the water which is supposed to take place at that part.

Some makers, on the other hand, cause the pitch to increase *across* the blade—finer for the leading or forward half of the blade, and coarser for the following or after half. The idea in this is that

the water driven astern is gradually accelerated. This can only be recommended in the case of very wide blades with high pitch-ratio.

Experience shows more and more, however, that little advantage, if any, is gained by a variable pitch; and uniform pitch is becoming the standard practice with most makers. The admiralty seldom adopt any kind of variable pitch.

SLIP.

The slip is the difference between the speed of advance of the propeller (supposing it to be working in an unyielding substance) and the actual speed of the ship. In other words, it is equal to the pitch multiplied by the revolutions, less the distance traversed by the ship. If the water did not yield to the propeller and flow sternward, the speed of the ship would be the same as the speed of the propeller, and there would be no such thing as slip; but water, being a fluid, is driven astern by the action of the propeller as the ship moves ahead. The rate at which the water is driven astern relatively to the surrounding water is usually said to be equal to the slip; but this is only true provided the pitch multiplied by the revolutions is equal to the speed of the race relatively to the ship, or, in other words, provided the propeller itself does not slip in the race. As far as the author can see, we have no means of ascertaining the truth of this.

The above, however, only relates to *apparent* slip, for it does not take account of the fact that the propeller is not working in still water, but in water in motion in a forward direction owing to the influence of the ship in passing through it; and, as it is the *propeller* that is under consideration, the speed of the propeller and not the speed of the ship through the water should be the basis in calculating the slip.

For example, if the pitch were 15 feet, the revolutions 81 per minute, and the speed of ship 11 knots:

Then speed of propeller $= \dfrac{P \times R \times 60}{6080} =$

$\dfrac{15 \times 81 \times 60}{6080}$ .... = 12 knots
Speed of ship .... = 11 knots

Apparent slip of propeller ...... = 1 knot

But supposing the wake to have a speed of 2 knots, then

Speed of propeller as before $= \dfrac{P \times R \times 60}{6080}$
.... = 12 knots
Advance of propeller through the water in which it works = $V - w = 11 - 2$ .... = 9 knots

"Real slip" of propeller .... = 3 knots

It is sometimes found that a propeller seems to have *negative* slip, that is to say, that the speed of the ship is (apparently) greater than the speed of the propeller which drives it. This negative slip is only found when the speed of the ship is taken instead of the speed of the propeller through the water; it is the apparent slip, not the real slip, of the propeller.

The phenomenon of negative slip is the cause of a vast amount of ingenious, if not always scientific, hypotheses to account for its existence. Everyone agrees that negative real slip is a physical impossibility. In the author's humble opinion negative apparent slip is also a physical impossibility, and therefore there is no need to account for thing which does not exist. This is on the understanding that "apparent slip" means $\dfrac{P \times R}{60} - V$ while "real slip" means $\dfrac{P \times R}{60} - (V - w)$; these are the usual definitions of the terms, and they are given here to prevent misunderstanding arising from the mere meaning of words. The explanation is simple enough, for, in order to calculate the slip, the pitch P must first be known; it is one of the factors in the calculation, and, in the author's opinion, no one knows what the true effective pitch of a propeller is. What is usually taken as the pitch of a propeller is the pitch of the after face of the blade, or rather, the mean of the various pitches found at different parts of the after faces of the blades. This is certainly not the effective pitch of the propeller with respect to its action on the water, one reason at least for this being that it takes no account of the curved back of the blade, and it is certain that this increases the true effective pitch, although no one knows exactly, or even approximately, what value is to be assigned to it. There are also other reasons for supposing that we do not know what the effective pitch of a propeller is.

The cause of negative slip often given is that the propeller is working in the wake of the ship, and therefore working in water which has a forward motion.

For example of this reasoning we may take a previous example. Supposing the speed of the ship to be 13 knots and the speed of the wake 4 knots.

Then speed of propeller, as before ... 12 knots
Speed of ship .... 13 knots

Apparent slip of propeller .... —1 knot

And speed of propeller, as before .... 12 knots
Advance of propeller through the water = 13 — 4 = ... 9 knots

"Real slip" of propeller .... 3 knots

This reasoning seems to take it that the forward motion of the wake is greater than the backward motion imparted to the water by the propeller, so that the water forming the race still has a slight forward motion after it has been acted upon by the propeller. We would then have a large volume of water (the wake) following the ship, *part* of that volume (the race) is *impeded* only (not even brought to rest) by the propeller. The net result of the wake and the race would be motion in the *same* direction as the motion of the ship. But the motion of the ship is due to re-action on the water, and therefore the net result must be water flowing sternward; the author thinks there is no doubt whatever about this, and that any theory which supposes that the net result on the water of a self-propelled vessel is motion of water in the same direction as the motion of the vessel is condemned from the outset.

An explanation of negative slip put forward by Mr. Barnaby is based on the fact that the feed water to the propeller is accelerated while still forward of the propeller; and the action of the propeller upon the water while in contact is to accumulate pressure, which has the effect of increasing the acceleration of the race after it has left the propeller; and that, owing to this, the slip or acceleration of the water in the race is always in excess of the slip of the screw as given by its "nominal" pitch. But it rather seems to the author that this not only explains negative slip, but it explains it away, for it means that what we call the pitch of the propeller is not the true effective pitch.

In connection with slip there is a paradox which should be noticed. It is quite true that the most efficient propeller is that which projects the greatest mass of water astern at the lowest speed. This is equivalent to saying that the most efficient propeller is that which has the least slip. But we know by experience that a very small amount of slip, or no apparent slip, or negative apparent slip, is a sure sign of inefficiency; and that a propeller giving no slip, or negative slip, should be changed as soon as possible, as it is not suited to the vessel. How are these apparently contradictory statements to be reconciled? Both are true; but while in the first statement efficiency is taken in a general theoretical sense, neglecting friction, or, in such a sense, for instance, as we should use if we were comparing the theoretical efficiency of screws and paddle wheels, or screw propulsion and jet propulsion, or even screw propulsion itself applied to different vessels, in the second statement efficiency is taken with respect to the actual results (which includes friction and a host of other unknown and incalculable factors) of a particular case. The explanation stated less generally is this: Theoretically, a propeller having a small amount of slip is efficient; but smallness of slip is invariably due to fineness of pitch; and the finer the pitch the greater the loss by surface friction, until a point is reached at which the loss by friction overcomes the gain in the theoretical efficiency, and any further reduction of pitch produces a loss in what may be called the actual efficiency.

CAVITATION.

In very high-speed vessels such as destroyers, the troublesome phenomenon termed "cavitation" is likely to occur if the blade surface be too small for the thrust developed. Cavitation is failure in the supply of water to the propeller, and results in the formation of a vacuum or cavity at the forward faces of the blades owing to the water being unable to follow the blades fast enough. It was first discovered by Mr. Barnaby during the trials of H. M. destroyer Daring in 1894. It may be likened to what would occur in the case of a pump plunger which rises so quickly that it exerts a pull on the water beneath it of more than 15 lbs. per square inch. In that case the pressure of the atmosphere is insufficient to cause the water to follow the plunger, and a vacuum or cavity is formed. In the case of propellers, a cavity is formed on the forward side of the blade if the peripheral speed is too high, on account of the head of water being insufficient to cause it to follow the blade; and the consequence is a reduced thrust.

At the surface of the water, cavitation would take place when the pull of the blade on the water exceeds the pressure of the atmosphere; and below the surface, when the pull exceeds the pressure of the atmosphere plus the pressure due to the head of water. This, however, leaves out of consideration, for the sake of simplicity, the fact that, owing to the water giving off vapor when the pressure is reduced, cavitation actually takes place when the pull is somewhat less than this.

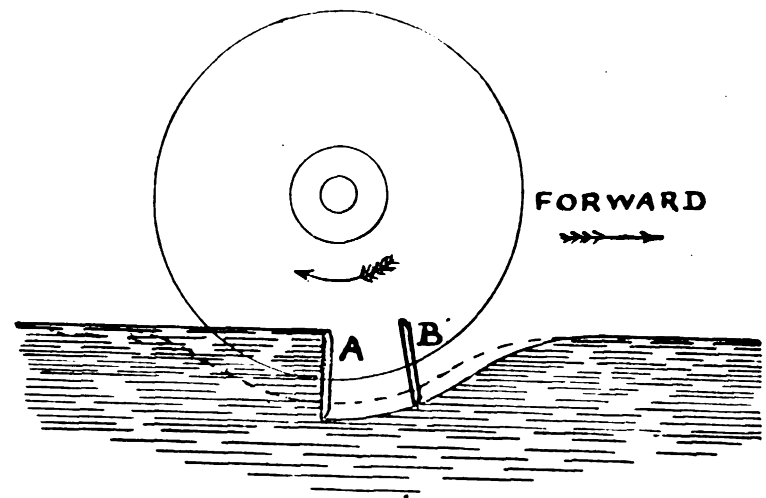
It commences to take place at the tips of the blades (where the circumferential velocity is highest) as they pass the highest point of their path where the pressure of water is least.

In destroyers and other high-speed vessels, the projected blade area should not be less than that which will ensure the thrust per square inch being less than about 12 lbs., otherwise cavitation may ensue.

Cavitation may be detected by a sharp ascent in the slip curve above a certain speed.

The thrust exerted by a propeller depends on the difference in pressure on the after and forward sides of the blades. It is therefore desirable to have as great a pressure on the after side and as small a pressure on the forward side as possible. Reduction of pressure on the forward side of the blade is equivalent to increase of thrust, and is to be sought for. It would therefore seem, on the face of it, that if the propeller revolved so rapidly that the water was unable to follow the blades, so causing the pressure on the forward side to fall to zero, a highly satisfactory state of things would be arrived at. But further consideration will show that if the water does not follow the blades, the pressure on the after side will also fall, as there would be a lack of water there also, so causing a greatly diminished thrust. It is a *sine qua non* that to obtain efficiency the water must be in contact with the forward side of the blade.

Cavitation is more easily grasped by considering the paddle-wheel. Referring to the sketch which shows a hypothetical case for the sake of simplicity, we will suppose we are dealing with only two floats A and B. The float A enters the water so rapidly that a cavity is formed forward of it. So far this float is concerned, a highly satisfactory state of things is arrived at; for we have a great pressure of water on the after face of the float and no pressure on the forward face, tending to create a great amount of thrust to drive the vessel ahead. But it is apparent that the float B has no water to engage with, and a loss in thrust is therefore inevitable. (What would actually happen in a real case, with the full number of floats and the vessel moving ahead, is that the water line in the vicinity of the wheel would probably take the form shown by the dotted line, that is to say, all the floats would be only partially but equally immersed).



Almost the same sort of thing happens to the screw-propeller; you cannot have great pressure on the aftersides of the blades while there is a cavity on the forward sides, owing to an insufficient quantity of water flowing past them.

Cavitation is due to the slip of the propeller; if there were no slip there could be no cavitation. This will be more easily seen by referring to the sketch of the paddle wheel. In this paper the author has touched upon a few of the leading features only of screw-propellers and propulsion; to deal with the subject at all fully would be impossible in a short paper. It is the most recondite and difficult subject that marine engineers have to deal with, and it gives rise to the greatest difference of opinion. But the author feels sure that, in time, the apparent vagaries of the screw will be entirely mastered by theory and reduced to mathematical formulae; and then we may expect marine engineering to progress by leaps and bounds.

SYMBOLS USED IN THIS PAPER.

F—Force or thrust exerted by the propeller in poundals.

m—Mass of water acted on by the propeller per second in pounds.

v—Speed of the race relatively to the ship in feet per second.

V—Speed of the ship in feet per second.

W—Weight of a cubic foot of sea water in poundals.

g—Force of gravity in poundals.

A—Area of cross section of the race in square feet.

w—Speed of the wake in feet per second.

V1—Speed of the propeller through the water in which it works in feet per second.

P—Pitch of propeller in feet.

R—Revolutions of propeller per minute.

M—Momentum of the race per second.

D—Diameter of propeller in feet.

The naval cruiser Newark has been turned over to the first naval battalion, New York state militia, and will be fitted up at once for her new duties. The naval militia will in the meantime retain its old headquarters on the Granite State, formerly the New Hampshire.

The New York & Porto Rico Steamship Co. has purchased the steamers Hugoma and Massapequa for service between New Orleans and Porto Rico. These steamers will be operated in conjunction with those already on the route, namely, the Arkadia, Berwind and Santurce.

PACIFIC MAIL STEAMSHIP CO.

The property of the Pacific Mail Steamship Co. is selling in the open market through its stock for about $6,000,000. The Southern Pacific holdings, which are just enough to give control, therefore have a value of a trifle over $3,000,000.

The company owns and operates lines of steamers plying between San Francisco and Honolulu, Yokohama and Hong Kong, also from San Francisco to Panama and Mexican and Central American points. Its property consists of 16 steel and iron ocean steamers with a gross tonnage of 68,000 tons, with other necessary floating equipment, and real estate, buildings, machinery, etc., located at Panama Bay, Colon, Hong Kong and other points.

Control of Pacific Mail passed to the Harriman interests in 1900 and shortly after the dividends which had been paid at the rate of three per cent per annum were suspended and all net earnings applied to the betterment and extension of the property.

The capitalization of the steamships of the Pacific Mail is about $300 per gross ton, which is rather high compared with the capitalization of Atlantic lines. The German and Cunard lines are capitalized at less than $100 per gross ton, or only about one-third the capitalization per ton of the Pacific Mail.

That the company is about 100 per cent overcapitalized is shown by the fact that for years the balance sheet has shown a deficit of from $10,000,000 to $11,000,000. In 1902 the Southern Pacific Co. began loaning money to the steamship company and this so-called floating debt amounted to $1,728,407 in 1903, since which time it has been gradually reduced until last year it was only $82,762.

The following table shows gross earnings, all expenses for operating, charges for depreciation, repairs and of every other nature and the net earnings applicable to dividends since the property passed under Harriman management:

Year.	Gross.	Expenses.	Net.
1901	$ 3,071,166	$ 2,903,345	$167,821
1902	2,029,346	2,337,271	*307,935
1903	2,827,506	2,819,225	8,281
1904	3,601,766	3,354,871	246,895
1905	5,775,783	5,348,126	427,657
1906	5,724,337	5,441,452	282,885
Total	$23,029,904	$22,204,290	$825,614

*Deficit.

As the outstanding capital stock is $20,000,000, there has been earned in the six years of Harriman control a little over 4 per cent in all on the stock after depreciation charges.

Earnings of the system are now higher than ever before, but the liberal policy of the Harriman management in depreciation charges reduces net earnings to practically nothing, and the following table will show that the charges are just as heavy in poor years as when earnings are at a record level.

Year.	Depreciation and repair.
1900-01	$ 345,168
1901-02	324,782
1902-03	314,823
1903-04	314,823
1904-05	495,683
1905-06	397,549
Total	$2,192,828

Taking this sum and the balance of net earnings above, the total amount applicable to common dividends before depreciation would be about $3,000,000, or 15 per cent for the six years, an average of 2½ per cent per annum. This compares, with 3 per cent anual dividends paid before control passed to Southern Pacific.

The Harriman interests paid about $50 per share for their controlling interest in the stock, so that their investment at the present time shows them a loss of at least $2,000,000, but the value of Pacific Mail stock is not to be judged by the porperty which it owns at the present time nor by its earnings either in the past nor even at the present time.

The future of the Pacific Mail lies along the lines of the building of the Panama canal. It will be a long pull, but the company has been in existence since 1848 and a wait of a few years more or less matters little when men make investments today for their grandchildren.

The Pacific Mail Steamship Co. has a large share of the Pacific trade, although late years have brought more competition than formerly, especially from Japanese lines. The opening of the Panama canal will be a great stimulus to Pacific trade and through it Pacific Mail will benefit. For the present there is no outlook for dividends and earnings will probably continue to be sunk in the property for some time to come.

INCREASE IN FRENCH SUBMARINES.

There are two classes of sub-surface boats in the French navy, the lines between being well defined; the submarine class is for strictly harbor defense purposes, while the submergible class is rated as sea-going, thus protecting within a greater radius. The two schools have had separate exponents in the French marine, and, except in the cases of "X" and "Z," there has been no modification from one to the other; these units were submergibles, designed by engineers who had theretofore created submarines, and are regarded as experiments not promising well. There is no example in the opposite direction.

According to the latest information, a total of eighty-nine units have been authorized to be built by the French, of which thirty-one were submarines and the remainder, fifty-eight, submergibles.

It may be justly assumed that the submergible class is preferred in France from the fact that of eighty-nine existing and projected sub-surface units fifty-eight are submergibles and thirty-one submarines—an even greater disparity promises, from recent developments, to obtain in the future; so far no disaster has ever occurred in one of the submergible class. The development of sub-surface boats in France has outstripped numerically that of any other country many times over; in the United States, for instance, we have in all twelve units, including those at present under order—less than one-seventh of the number of the French, with many times the number of harbors to defend. The curve of displacement, chronologically considered, has been extremely irregular in the submarine class, while in the submergible class there has been a steady increase in tonnage, as will be seen from the appended condensed table:

	SUBMARINES.	
1888	Gymnote	30 tons.
1893	Gustave Zede	270 tons.
1899	Morse	146 tons.
1901	Farfadet	185 tons.
1903	Perle	68 tons.
Bldg.	Guepe	44 tons.
	SUBMERSIBLES.	
1899	Narval	200 tons.
1904	Aigrette	250 tons.
1905	Omega	375 tons.
Bldg.	Emeraude	430 tons.
Bldg.	"Q," 53-60	500 tons.
Projected, 800.		

Since the data was collected on which the above statement is based Chief Engineer Laubeuf has resigned from the French navy, and the present minister is now proceeding to build several units of largely increased tonnage in the submergible class.

The San Francisco office of the General Electric Co. is now permanently located in the Union Trust building in San Francisco. Since the fire the office has been located in the Union Savings Bank building at Oakland, large temporary warehouses having also been erected in the same city.

The Osaka Mercantile Marine Co. has contracted with the Kawasaki Dock Yard and the Mitsubishi Shipbuilding Yard of Japan for three 6,000-ton steamers to cost $520,000 each, which will be used in the new American service.

REGULATIONS FOR PASSENGER VESSELS.

Steps were taken at the final session of the Navigation Conference, held in the rooms of the Board of Trade and Transportation in New York last week looking to a permanent organization which will take in charge all matters pertaining to the work of securing an extension of the navigation laws of the United States to include steam and sailing vessels of all classes, and for an extension of these laws to meet conditions as they exist—for the better protection of life and property at sea.

On motion a permanent committee of the membership of the conference was authorized, with President Frank Green, Admiral Coghlan, W. F. Humphreys, of Boston, and Jacob W. Miller, of the Fall River line, as a skeleton, with such others as these gentlemen may see fit to appoint, to receive and consider all resolutions, etc., and to report to the conference at a meeting to be held at the call of the chair subsequent to the next meeting of the national congress.

A sub-committee was also authorized to draft the sense of the conference into the form of a bill to be presented to congress.

Just before the adjournment of the conference Jacob W. Miller, of the Fall River line of Sound steamships, presented the following recommendations to the permanent committee:

1. That on and after a certain date every steam vessel carrying passengers shall have at least five watertight bulkheads with no doors or openings below the main deck.

2. That passenger steamships of a certain size shall have at least two fireproof bulkheads extending to the upper decks.

3. That all coastwise passenger steamships shall carry a wireless telegraph apparatus, providing that the government shall so arrange that messages may be transmitted to the shore through its seventeen or more stations without cost, thus relieving the steamship companies of the necessity of paying exorbitant rates to the wireless telegraph companies.

4. That Rule 9 of the rules of the road at sea be amended so as to make them practical and comprehensive.

5. That the examination for officers of passenger vessels who are required to have licenses, be made the same for all districts, and that a book of requirements be made and published under government supervision.

6. That the regulation which bars unauthorized persons from pilot houses be amended to include vessels of all classes.

7. That the freight compartments on all passenger vessels be lined with metal or other fireproof material.

8. That all passenger vessels be provided with searchlights.

9. That guns and gun carriages on all vessels be subject to inspection.

10. That the old, traditional and confusing terms of starboard and port be abolished and that strict regulations be promulgated providing for uniform methods of handling ships.

The above recommendations were referred to the committee without discussion, together with one from Lieutenant F. S. Van Boskerk, of the U. S. Revenue Cutter Service, to the effect that all vessels, whether in coastwise or deep sea service, shall be equipped with wireless apparatus.

"This is one safeguard against disastrous results from accidents which can be put into effect at once," said Lieutenant Van Boskerk. "Its practicability has been demonstrated and the dictates of common humanity call for it."

Together with the Point Judith resolution of Wednesday, the following resolutions were reported to the resolutions committee and unanimously adopted:

"Resolved, That the measures already taken by the Hon. Oscar Straus, secretary of commerce and labor, to render the steamboat inspection service more efficient, are viewed by this Navigation Conference as a proof of his earnest desire and ability to maintain and develop the American merchant marine and encourage every movement which has for its object the protection of the lives of the crews, as well as passengers, on all classes of vessels.

"Further Resolved, That this conference hereby thanks Secretary Straus for his work in this direction and that the organization here represented pledge him their hearty co-operation.

"Resolved, That this meeting petition the president of the United States, through the secretary of commerce and labor, to appoint a commission for the purpose of drafting amendments to, and revisions of, the navigation laws, particularly in respect to the rules of the road, with a view of securing more adequate precautions for the preservation of life on all kinds and classes of vessels, and with the view of bringing under the inspection service all classes of vessels, particularly in respect to their construction, equipment and crews; and that it be recommended that one-quarter of this commission consist of experienced masters of vessels and pilots, that one-quarter consist of experienced engineers, that one-quarter consist of owners of vessels, and that the remaining quarter consist of experienced builders of engines and hulls, of lawyers, and such others, including an official of the U. S. navy, as may seem desirable; and that the chairman of this meeting appoint a committee to draft such petition."

NECESSITY FOR TRAINED MEN.

One of the interesting addresses before the conference was that of Mr. Lincoln C. Cummings, of Brookline, Mass. He said:

"I shall ask this conference just one question, and make but one request, and I will take the shortest possible time to do so. Matters of detail regarding different life-saving devices are of elemental and collateral importance, as to the final determination of the preparedness of the steamship for passengers, but the complement of trained men to successfully handle them is the fundamental issue now before this conference. Is not the personnel and training of the sailors of our merchant marine equally as important to the safety of lives as the training and good shooting of our navy? Which yields victories of both peace and war?

"The steamer at sea, with her human freight, while a single unit, must be organized upon the assumption that this single unit shall become in an accident as many units as she has life boats, each of which should be as expertly manned as the original unit herself. If the public are to be safe at sea, a steamer should have trained officers for each position, and why not trained men for each life boat? Is it right for this vital part of her equipment to be weak and inefficient in an accident? As much depends upon each man in the life boat as upon each officer of the ship itself. When it comes to the final test, it is more the fiber and quality of the men handling the boats that counts than it is of the means of escape.

"The recent destruction of the steamer City of Troy by fire, in which proper discipline and judgment prevailed against great odds, in saving every life, well illustrates the point, and serves also to impress upon us that it is where such organization and training have been lacking that the great loss of precious lives has occurred. The right thing at the right time is the expression of training.

"The demand of the citizens of this country for competent seamen is one which steamship companies should comply with, as a matter of good business policy, in advance of any compulsory legislation, and which legislation they should not oppose upon the same grounds.

"The conditions today are that once the captain, mates, pilot and engineers are licensed, and the boat itself is inspected and passed no official attention can be paid to the crews. They can be picked up from any quarter and regardless of any qualification for the work. It is true that some life boat drills are re-

quired, but the fact is apparent that they are only a perfunctory ceremony. Steamship companies licensed to carry passengers enter into a contract for their safety as well, and should be required to provide experts for every life boat as much as officers for the ship itself. Accidents and perils of the sea, cannot be too scrupulously guarded against when human life is at stake. Sailors of all passenger steamers should be required to pass an examination as to their qualification and fitness before United States inspectors. Steamers before they become eligible for license, should be required to train and practice their crews in the skillful handling and launching of boats in the roughest water and under the conditions, as nearly as possible, which are met with in an accident at sea. No license should be granted until such practical demonstration of preparedness for passengers has been made at sea in the presence of inspectors, and such license should be continued in force only so long as the required standard is maintained.

"Similar government examinations should be made from time to time, and without notice, during the year. While it is claimed that boat and fire drills are made regularly, yet the results obtained do not indicate their effectiveness nor display a high morale of the crews, but show that more strenuous methods must be adopted, adequately to protect the public. Trained seamen can be obtained to properly man every steamship and if they cannot be found in full supply, an apprentice system should be provided, from which shall graduate crews of a high order of efficiency and perfect discipline. While we are fortunate in having such vigorous and thorough enforcement of existing laws, as afforded by our distinguished secretary of commerce and labor, yet we should secure the passage of a law which shall vouchsafe these conditions to all future generations. For this prerogative of the federal government of license is no mere formal ceremony, but upon its proper issuance depends the very lives of its citizens. This license must be a patent of protection to each passenger, and to every hearthstone that the steamer so licensed is known to be and is in fact properly constructed, equipped, officered and manned.

"This movement for government inspection of crews has been undertaken in the belief, that by the enlargement of the powers and the duties of the department of commerce and labor, that the lives of men, women and little children, shall be better safeguarded and protected.

"This is the ultimate purpose of the movement, and the immediate expression of all citizens and of this conference is desired that something thus concrete may be laid before the president, through Mr. Secretary Straus, that shall justify Washington in at once adopting some emergency measure which will render safter transportation this summer, and that will save lives. I ask you to answer only one question: Do you approve of inspection of crews of American passenger steamers by the government?"

GOOD YEAR FOR KOSMOS LINES.

The annual report of the Kosmos Steam Navigation Co., of Hamburg, just to hand, shows another satisfactory year. The balance sheet shows that with gross earnings amounting last year to 5,292,584 marks (against 4,948,610 marks in 1905 and 3,367,681 marks in 1904), the expenses only amounted to 175,018 marks, leaving a surplus of 5,116,941 marks (against 4,803,624 marks and 3,228,157 marks). Out of this sum 3,111,238 marks are written off for depreciation, 291,140 marks are added to the repairing fund, and 1,540,000 marks paid as dividend, and (after payment of the directors' fees) a small amount is carried forward. The dividend is 14 per cent, against 14 per cent for 1905, 10 per cent for 1904, and 8 per cent for 1903. The fleet sustained no heavy casualties last year, and consequently the insurance reserve fund was increased by 274,766 marks, and now it stands at 1,798,503 marks. Notwithstanding the successful result of the year's working, however, the earthquakes at San Francisco and at Valparaiso seriously dislocated the company's business and caused much delay and extra expense.

The report enters at some length upon the details connected with these catastrophes, and makes serious complaints against the port authorities at Valparaiso on the score of their laxity in making arrangements for the accommodation and dispatch of shipping both before and after the earthquake.

The navy department has recently given to every vessel in the Atlantic fleet a permanent home port. This is a great boon to the men in the fleet under the command of Rear Admiral Evans, as it makes it possible for them to see their families more frequently, owing to the fact that they know at what port they will stop and where repairs are to be made.

The republic of Brazil is to have a battleship of the Dreadnought type, contract having been placed with Vickers Sons & Maxim, Barrow-in-Furness, England.

A STUDY IN GRAPHITE.

The series of tests of graphite made by Prof. W. F. M. Goss, of Purdue University, have been embodied in book form by the Joseph Dixon Crucible Co., Jersey City, N. J. These tests were not made with a view to finding points for or against graphite, but were conducted in the spirit of scientific research. The study opens with a dissertation by Prof. Goss based upon the conclusions drawn from the results of the tests. Then follow complete descriptions of the tests together with illustrations of the testing machine made from photographs and drawings. The condition of the bearings and journal is shown by photographs taken at different stages of the tests. Because of the high character of the matter and the heavy expense attached to the conduct and publication of these tests, it was decided to make a nominal charge of twenty-five cents a copy for "A Study in Graphite." A limited number of copies, however, will be distributed free of charge to all those interested in the science of graphite lubrication. Application should be made to the Joseph Dixon Co.

MOST APPROVED SHIPPING DOCKS.

The Atlanta, Brunswick & Atlantic Railway and Brunswick Steamship Companies' new docks at Brunswick, Ga., are about 40 per cent completed. The plant covers about seventy-five acres and is a model in every detail. A new and decidedly advantageous feature is the use of reinforced concrete piling ranging from twenty-five to fifty-six feet in length and eighteen feet in diameter. The piling is driven in the same manner the old style wood pile is driven. The piles are constructed with a 2-foot pipe molded into the center of the pile, beginning about one-half distance from the top, extending through the center to the point driven into the sand. Water is forced through this pipe, thereby forcing the sand from the pile while being driven.

A special building is under construction to be used in the generating of steam power and to generate electricity. All cranes and winches are to be operated by electricity. It is estimated that the cost of the plant will be about $800,000.

Four steamers of 4,000 tons capacity are operated by the company, plying between Brunswick and New York, and one of 3,000 tons capacity in freight and passenger trade between Brunswick, Havana and New York, carrying lumber, crossties, resin cotton and general merchandise.